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Making Iron Channel Frames

Cast Iron Has Proved Itself To Be the Most Satisfactory Material To Use in the Construction of Frames Supporting at Times as Many as 110 Revolving Spindles

BY H. R. SIMONDS

IN THE early days of the textile industry when a considerable quantity of the special machinery was imported, the foundry capacity of New England was taxed at times to keep up with the demand for building columns. Immense, many storied mill buildings in Lowell, Lawrence and in many other towns and cities on both sides of the rushing Merrimac between Newburyport, Mass., and Concord, N. H., are built of brick and the floors between the exterior walls are supported on rows of cast iron columns. It is claimed that one foundry in Lawrence supplied 2000 columns in one year during the construction of one of these mill buildings and the same applies in greater or lesser number to every mill building in the territory. They all are built on the same general plan.

Cast iron in the shape of columns, beams, struts and braces, practically has ceased to be a factor in building construction in recent years, but it has come into more extended use every succeeding year in the manufacture of textile machinery. American ingenuity has kept pace with the growth and expansion of the industry and has invented and applied improved machinery and processes to such an extent that no longer is it necessary to import foreign machinery. On the contrary, a considerable quantity of American made textile machinery now is exported. The methods employed in the manufacture of certain castings that form component parts of this machinery are highly spe-

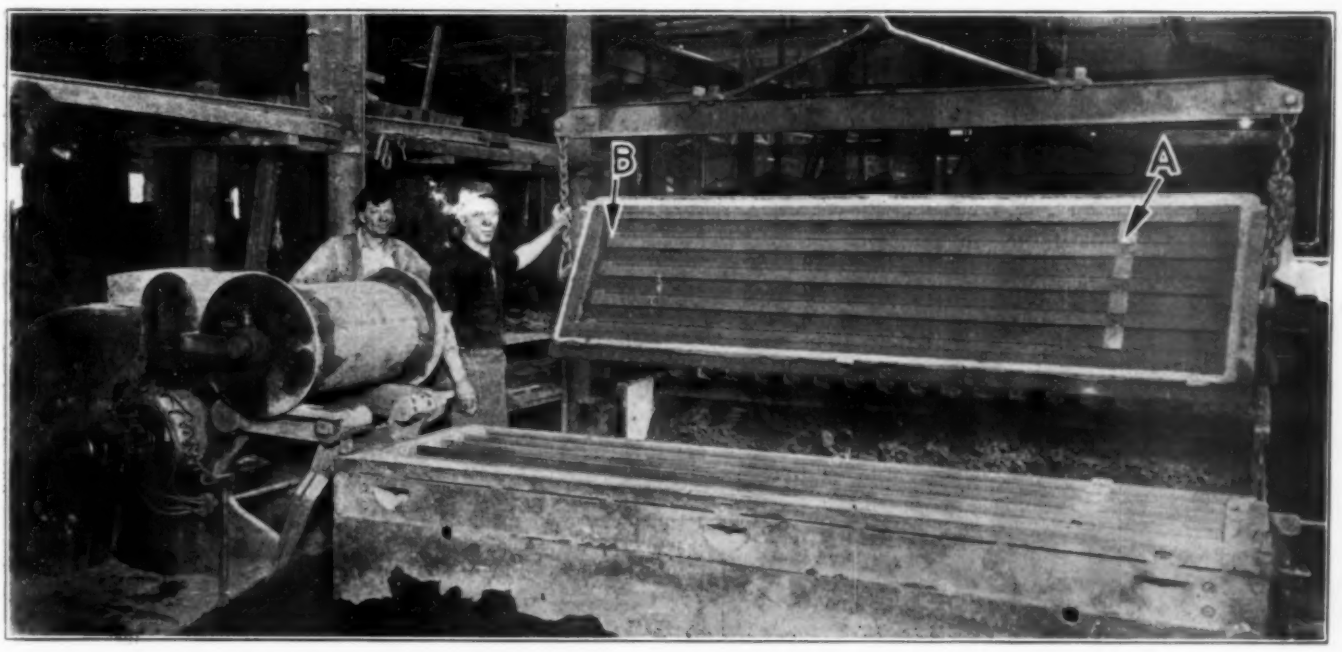
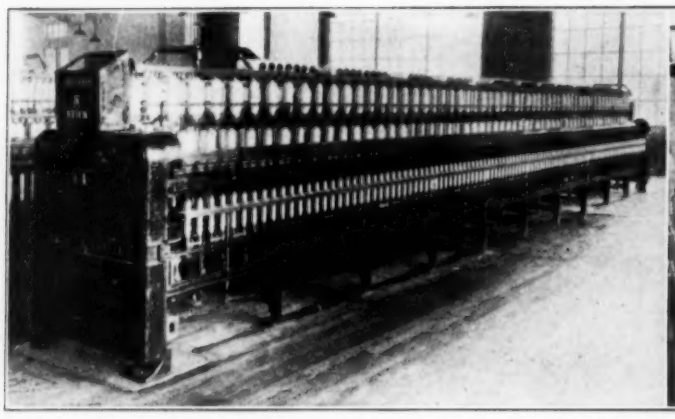


FIG. 1—PATTERNS ARE ATTACHED TO A STRIPPING PLATE MOUNTED ON AN ELEVATED, ENCLOSED FOUNDATION—THE SAND IS RAMMED BY PASSING A 500-POUND ROLLER TWICE BACK AND FORTH FROM END TO END OF THE FLASK



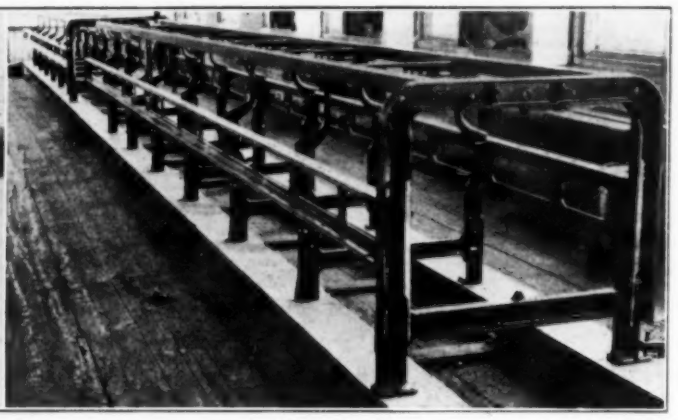


FIG. 2—A COMPLETE SPINNING MACHINE AS IT APPEARS ON THE FLOOR OF A MODERN MILL FIG. 3—A SPINNING MACHINE IN COURSE OF ASSEMBLING ON THE FLOOR OF THE ERECTION DEPARTMENT

cialized and are controlled by a few companies, one of which is the Saco-Lowell Co., with head offices in Boston and foundries and erection shops in Biddeford, Me., Newton Upper Falls, Mass., and Lowell, Mass. Successive steps in the production of long channel beam castings are shown in the accompanying illustrations.

Rolled steel beams are replacing cast iron columns in all new textile mill construction and an outsider might be justified in wondering why steel channels and other shapes are not employed in the construction of machinery typified by the spinning frames shown in Figs. 2 and 3. The explanation given is that structural steel lends itself more readily than cast iron to vibration and in addition lugs and other attachments can be cast integral with the frame instead of being bolted on or riveted as would be the case in the event that rolled steel sections were employed.

A complete spinning machine on the floor of a modern mill is shown in Fig. 2 and another machine partly assembled on the erection floor of the manufacturing company is shown in Fig. 3. The general skelton-like appearance of nearly all the castings may be noted, particularly in Fig. 3. The two upper pieces are channel beams and a special open web channel section beam is shown extending from end to end at each side. The machine is designed to carry 110 spindles and it is quite apparent that the most rigid construction is an essential feature of a frame to withstand the vibration of such a large number of spindles whirling simultaneously at an average speed of 10,000 revolutions per minute. In trying to meet the peculiar conditions incident to this most peculiar industry the machine designers presented the foundrymen with several unusual and difficult problems. The manner in which the castings are turned out in quantity, straight and true to pattern is evidence that the foundrymen have developed a method and devised equipment to solve the problem in a highly satisfactory and efficient fashion. Practically every casting in the complete frame presents peculiarities from a foundry viewpoint but it is the purpose here to consider only the long channel beams.

Approximately 150 beams of assorted shapes similar to those shown in Fig. 6 are made daily in one section of the Saco-Lowell foundry in Lowell, Mass. The patterns are mounted on a stripping plate attached to an elevated enclosed frame and the sand is rammed by passing a roller over it twice. The equipment is shown in Fig. 1. Individual stripping plates are provided for the various types of beams required and readily may be changed on the frame in front of the roller.

Present method of making the castings marks a decided advance over the method formerly employed where two molders ramming the sand by hand turned out 16 beams a day. Under the present system six handy men have been broken in to attend the machine and their combined effort is responsible for 150 castings a day. Taking the comparison on a pound basis, six men and the molding machine produce 30,000 pounds of

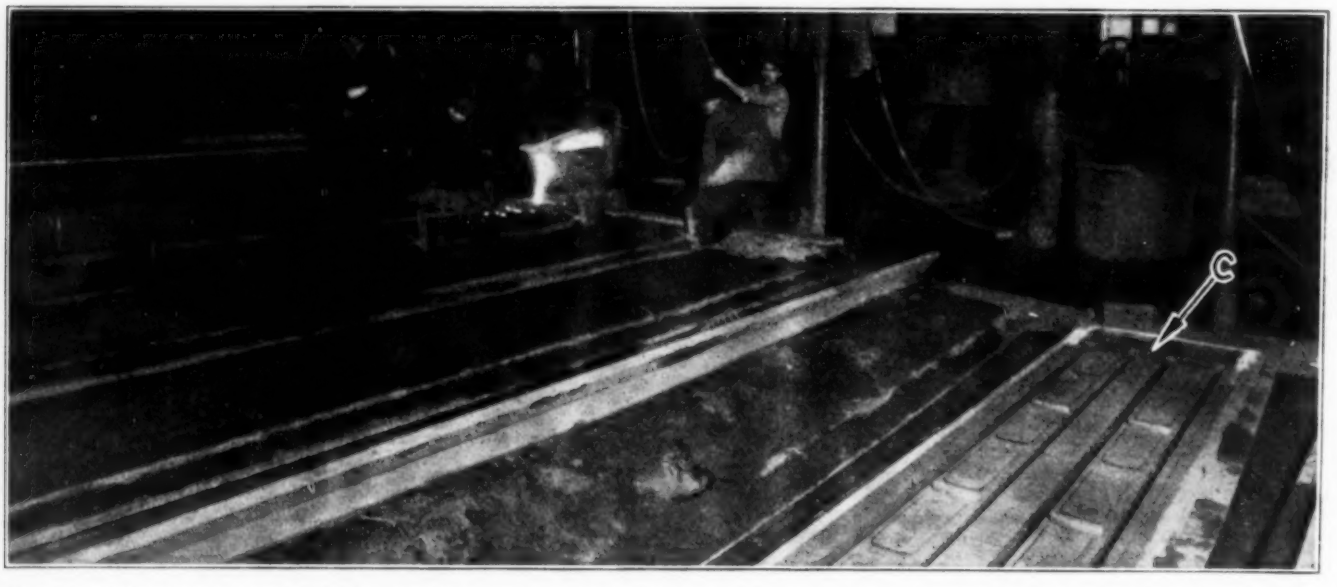
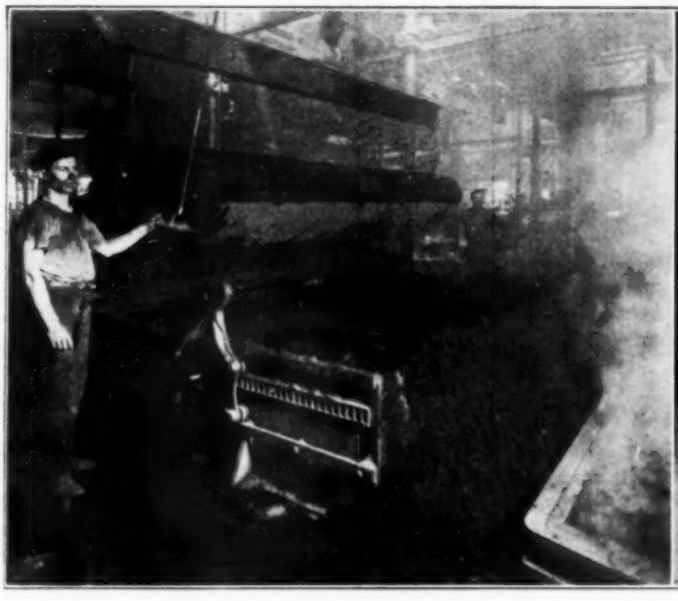


FIG. 4—THE MOLDS ARE POURED FROM ONE END THROUGH GATES THAT ARE PARTLY SEPARATED FROM THE MOLD BY STOP-OFF CORES—THE IRON ENTERS THE MOLD NEAR THE BOTTOM OF BOTH SIDE MEMBERS OF THE CHANNEL

good castings in a day, or, at the rate of 5000 pounds per man. Under former conditions two men without a machine turned out 3200 pounds of good castings, or 1600 pounds per man per day. From this it is apparent that the new method is 68 per cent more efficient than the old.

The molding labor is paid on a piece work basis and the remuneration is divided equally among the six men constituting thegang. Each has a specific duty to perform, but that does not prevent him from exchanging jobs occasionally nor does it prevent one man doing part of another man's work in addition to his own when circumstances seem to warrant. Lowell, Mass., in this period. The drags are barred as well as the copes and therefore no bottom plates are required.

One bay of the foundry is devoted to the manufacture of the long beam castings and is served by an electric traveling crane and also by a device for removing the sand from the flasks after the castings have cooled sufficiently. Usually the entire casting is molded in the drag and covered by a perfectly flat cope. In other instances the casting is molded entirely in the cope which then is closed down on a flat drag. The first method is illustrated in Fig. 4 and the second method in Figs. 1 and 8. Additional items of interest to be noted



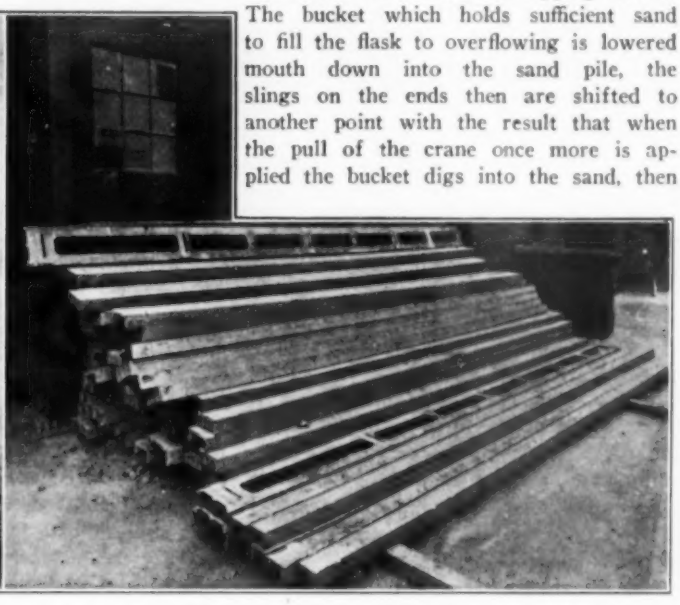


FIG. 5—THE LONG BUCKET IS PROVIDED WITH A SPECIAL DEVICE AT EACH END BY WHICH THE CENTER OF GRAVITY IS SHIFTED IN SUCH A MANNER THAT THE BUCKET CAN BE FILLED OR EMPTIED DEPENDING ON WHICH HOOK IS ATTACHED TO THE HOISTING BEAM FIG. 6—TYPICAL BEAM CASTINGS

20th century is far removed from the gay capital of France in the 17th and a band of grimy molders bears little resemblance to a group of beplumed and beribboned court gallants, but the truth of D'Artagnan's slogan: One for all and all for one, apparently is appreciated as fully by these men engaged in earning a daily wage as it ever was by Dumas' famous four inseparable, swashbuckling bravos.

Maintains Flask Rigid

Molds are made in heavy, rigid, one-piece steel flasks 17 feet long and 30 inches wide, provided with bars on the inside and a heavy reinforcing flange encircling the outside. In some of the flasks the flange surrounds the top and bottom edge in the usual manner; in others a single flange surrounds the body of the flask approximately at the center line. The purpose of both forms of construction is to maintain the flask rigid and true under comparatively severe operating conditions for an indefinite

in Fig. 1 are the style of gate employed, shown to the left of the illustration and, the manner in which stop-off cores are employed at *A* to make castings shorter than the pattern. In the example shown four narrow patterns are molded in the one flask. The number of patterns in any one flask varies from two to four depending on the width.

Metal patterns, straight and true, with metal section designed as nearly uniform as possible to minimize contraction and warping strains, with the sides tapered to provide easy withdrawal from the sand, are provided for making the castings. They are mounted on the machine shown in Fig. 1 which serves for making both cope and drag by a suitable exchange of pattern equipment. All the drags are made first and then the top of the machine is changed for making the copes. The flask parts all are barred and may be employed either as copes or drags, depending on whether it is desirable to mold the castings with the web up or down. Where the webs are to be cast down the drags are rammed on a flat plate and present the appearance shown in Fig. 8. Where the beams are to be cast with the web up after the manner practiced in the average foundry, they are rammed on a stripping plate containing the full patterns and the cope is rammed on a flat plate.

Making the Mold

The molding machine and the shaking out device are in close proximity to minimize the distance sand and flasks are carried to the molding station. After the flask is placed on the machine it is filled with sand from a long bucket provided with an automatic tipping device. The bucket which holds sufficient sand to fill the flask to overflowing is lowered mouth down into the sand pile, the slings on the ends then are shifted to another point with the result that when the pull of the crane once more is applied the bucket digs into the sand, then rolls over until the mouth points upward, and is full. In other words shifting the center of gravity reverses the position of the bucket. The bucket is lowered on to the flask and by reversing the filling process the contents are spilled among the bars and over the patterns. The bucket is returned to the sand pile and the crane is utilized to lift the rammed flask from the molding stand and shift it to position on the pouring floor.

With between 400 and 500 lifts to make every day it is apparent that the speed and skill of the craneman is an important factor in regulating the day's production, but a well regulated division of specific duties among the remaining five operators also plays an important part. Two men finish and close the molds, two operate the molding machine and the fifth makes up the runners, arranges for change of patterns and other incidental duties.

By referring to Fig. 1 it will be noted that a rather unusual type of molding

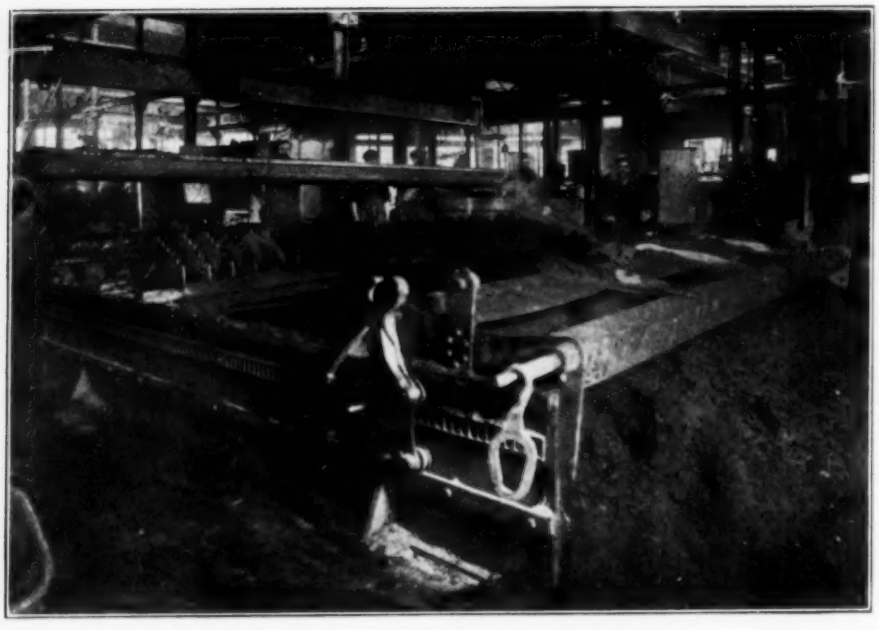


FIG. 7—WHEN THE FLASK IS LOWERED A SET OF SAW TOOTH BARS LOOSENS THE SAND AND ALLOWS IT TO FALL ON THE FLOOR WHERE IT IS RECONDITIONED

machine is employed to ram the sand in these long flasks. It is patterned after the design introduced by the late H. L. McDonald while he was vice president of Snead & Co. Iron Works, Jersey City, N. J. The sand is pressed down into the flask under a roller which is traversed back and forth twice from one end of the flask to the other. The operators peen ram the sand close to the inside wall of the flask and also between the patterns before the roller is employed. The roll on the machine shown in the illustration weighs 500 pounds and rams the sand satisfactorily in a flask 17 feet long, 30 inches wide and 7 inches deep.

Gated at One End

Before the rammed drag is lifted from the machine, the sand is scraped off flush on the bottom to present a straight, flat surface when it is placed on the prepared bed. The cope is not rolled over and, therefore, since there is neither necessity nor advantage in removing the superfluous sand, the sand on top of the cope is not disturbed but left in the condition in which it appears after the roller has been passed over it. This feature is quite apparent in Fig. 9. The pattern plate is vibrated before and during the time the pattern is lowered away from the mold. Any necessary retouching is done to the drag mold after it is placed on the floor but the mold for the cope is examined and retouched while it still is suspended from the crane in the position it occupied on the ramming table, that is, face down. Usually no retouching is required. The cope is lifted directly from the machine and placed on the drag.

The style of gate employed varies to some extent depending on the size of the casting and also whether the patterns are molded in the cope or the drag. A thin, flat gate almost the entire width of each pattern connects the web part of the mold with a deep runner extending across the face of the cope at one end. This runner is fed by two upright sprues which in turn receive metal from a common basin built on top of the cope after the mold is closed. This style of gate is illustrated at *B* Fig. 1 where the molds are made in the cope part of the flask.

Where the mold is made in the drag the style of gate shown at *C* Fig. 4 is employed. A suitable stop-off core directs the metal into the bottom of each of the side walls of the beam and to some extent serves as a skimmer between the runner and the casting. On the outside of the cores the gates are connected to a runner and sprues similar to those employed where the molds are made in the cope.

Poured From One End

Under ordinary foundry conditions castings of this character would be poured from both ends, but in the Lowell foundry no difficulty is experienced in producing satisfactory castings poured from one end; this despite the fact that some castings are almost 17 feet long with an average metal thickness of ½ inch. Adjustable clamps shown in place in Fig. 9 are employed to hold the cope and drag together. Usually two flasks are clamped at a time to receive the contents of a ladleful of iron. While the ladle is making the round trip to the cupola and back, the clamps are shifted to the two flasks next in line.

The ladles employed to pour the castings have an individual capacity of 2500 pounds. The weight of the castings vary from time to time depending on the particular patterns in use, but will average 1100 pounds to a flask and, therefore, a full ladle usually is sufficient to pour two flasks. The ladle is supported on a chain hoist suspended from a monorail directly above the runner end of the row of flasks and below the crane runway. Two men tip the ladle while a third man attends the chain hoist.

To prevent the castings from warping they are allowed to remain in the mold for a minimum of 45 minutes after which they are removed and the sand in the flasks is shaken out over the device shown in Fig. 7. A number

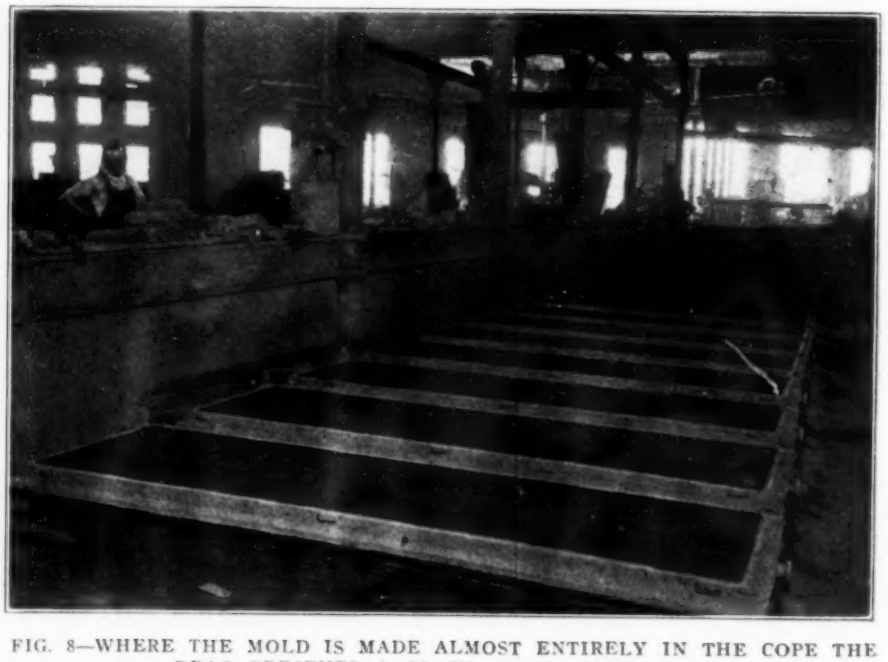


FIG. 8—WHERE THE MOLD IS MADE ALMOST ENTIRELY IN THE COPE THE DRAG PRESENTS A PLAIN, FLAT APPEARANCE

of pyramided saw tooth bars are mounted on a stand in such a manner that they pierce the sand between the bars of the flask when the latter is lowered down by the crane. By alternately raising and lowering the flask a few times all the sand is loosened from between the bars and falls on the floor. The shaking-out device is shoved out of the way after several flasks have been dumped and the sand, rejuvenated with a certain amount of new sand, is wet down and cut over by hand in readiness to fill the long bucket. Succeeding flasks are shaken out over the device in its new position and after a sufficient quantity of sand has been accumulated at that point the device is moved back to its original position, and the sequence repeated.

Castings Sometimes Warp

Occasionally a casting will warp slightly from a straight line. When this happens it is straightened in a comparatively simple manner by placing it convex side up on two wood blocks set about 8 feet apart. The plunger from a pneumatic press forces the center below a straight line and when the pressure is released the beam springs back to a straight line. The experience of the operator guides him in determining the amount of deflection required. Usually the beams are bent while cold, but in extreme cases, for example where the beam has warped over ¾-inch, it is heated to a dull red by an oil torch before it is placed under the press.

After the castings are straightened they are pickled in a sulphuric acid bath and then placed on a long table in the cleaning room where the flat surface is ground smooth by grinding wheels suspended from a trolley running from one end of the table to the other. The wheel frame is attached to a heavy spring which keeps it away from contact with the casting until the operator catches a handle on either side and forces it down on the face. The trolley supports the weight of the wheel and frame while the operator guides it along the face of the casting from one end to the other. Two men clean all the castings turned out by the six-man gang on the molding floor.

Opens Western Branches

The Chain Belt Co., Milwaukee, manufacturer of chain, transmission machinery and conveying equipment, formerly represented on the Pacific coast by Meese & Gottfried Company, San Francisco, has established direct factory branches and warehouses in Portland and Seattle.

The northwest territory, with headquarters at 67-69 First Street, Portland, will be in charge of Allen C. Sullivan.

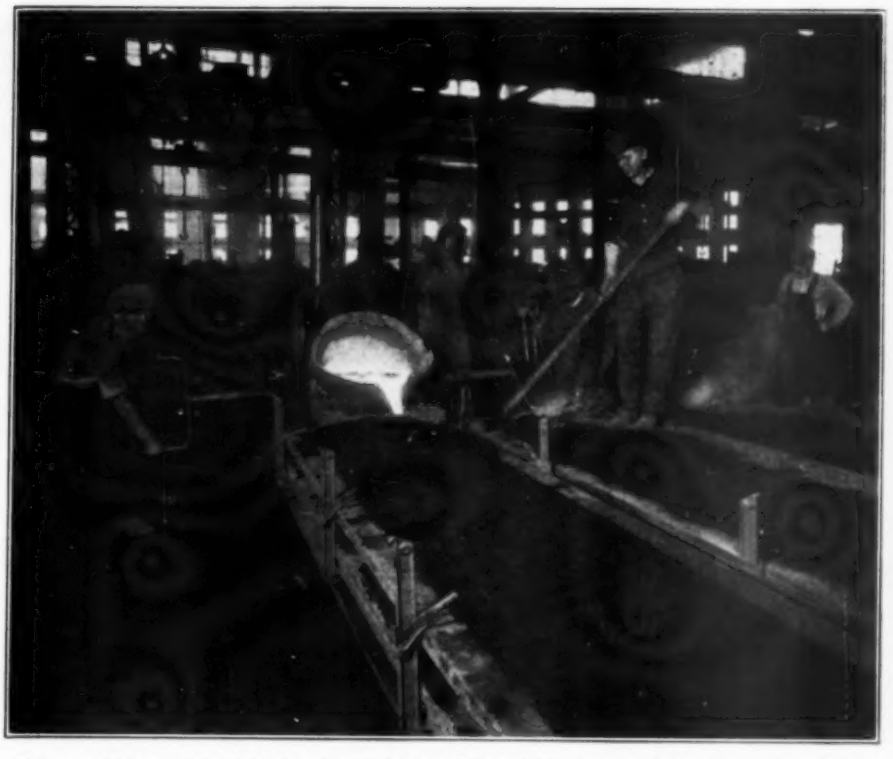


FIG. 9—COPE AND DRAG ARE HELD TOGETHER BY QUICK ACTING ADJUSTABLE CLAMPS

Mr. Sullivan was formerly connected with the Allis-Chalmers Co., Milwaukee, and more recently with Smith & Watson Iron Works, Portland, as chief engineer. Just previous to his association with the Chain Belt Co., he was engaged in special sawmill work as consulting engineer.

Don B. Catton, formerly with Meese & Gottfried Co. and later engaged in the machinery supply business on his own account will be the special sales representative for the Portland office. The Seattle and British Columbia territory will be handled by Wm. F. Nichols out of the Seattle office.

Book Review

The Metallurgy of Iron and Steel, third edition, by Bradley Stoughton, 519 pages, 5¾ x 9; published by McGraw-Hill Book Co., Inc., New York, and supplied by THE FOUNDRY, Cleveland, price $4.00.

A number of chapters in this book have been thoroughly revised and others have been modified to bring the book in line with the new developments in the iron and steel industry since the second edition in 1911. Some of the operating sections had to be completely rewritten, including the chapters entitled Blast Furnace, Purification of Pig Iron, Open Hearth, Electrometallurgy, Malleable Cast Iron, Metallography, and Alloy Steels.

The book covers the iron and steel field from smelting pig iron to rolling shapes and casting iron, including a chapter on metallurgical fuels. This book would be of interest to the foundryman who wishes to secure a broader knowledge of the iron and steel industry, especially as it explains many of the theories accepted in regard to the metallurgy of iron and steel and illustrates the statements by charts and micrographs.

Announce Sales Changes

The Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. has made changes in its sales organization effective Nov. 1. H. W. Gledhill, eastern sales manager, has opened offices 121 N. Broad St., Philadelphia, having as an assistant sales representative, G. M. Rumsey. The New York office, 30 Church street, will be managed by A. J. Barnes who will also be in charge of export sales and advertising. He will be assisted by R. W. Hurst, R. C. Vaughn, H. Aber and F. J. Kinney. The Pittsburgh office, Union Arcade building, will be in charge of H. A. Baugh. The Baltimore office, Lexington building, will be in charge of D. B. Patterson. The Chicago office is in charge of W. B. Briggs, Peoples Gas building. The San Francisco office, 16 California street, is under the supervision of W. H. Ringe. The Birmingham, Alabama, office, 507 Woodward building, will be in charge of F. R. Quigley.

Melting in Electric Furnace

Production of Synthetic Cast Iron Is Outlined and the History of the Heat Is Indicated by Analyses—Methods Shown for the Addition of Carbon to the Bath

BY JAMES L. CAWTHON, JR.

PRODUCTION of synthetic cast iron consists of melting steel scrap, or combinations of iron and steel scrap, in the acid or basic electric furnace, with a highly carbonaceous material to give the necessary carbon content to the iron; and making adjustments in the percentages of manganese, silicon, sulphur and phosphorus, to give the desired characteristics in the finished metal. The process is fairly simple in its chemical aspects, though a certain amount of experience and judgment is necessary if the results are to be satisfactory from an economic and physical standpoint. For the purpose of encountering some of the problems, the average conditions and history of a heat are related as follows:

An iron is to be prepared which shall contain 3.25 per cent carbon; 0.70 per cent manganese; 0.50 per cent phosphorus or under; under 0.07 per cent sulphur, and 1.90 to 2.10 per cent silicon. This would be an ordinary soft gray iron. The material available for charging is steel turnings of the following analysis: Carbon, 0.20 to 0.30 per cent; silicon, 0.25 per cent; sulphur, 0.05 per cent; manganese, 0.60 per cent; phosphorus, 0.05 per cent. A basic furnace is discussed first.

The charge per ton for this heat in the basic furnace will be made up as follows: 2000 pounds turnings; 75 pounds coke (coal or oil-still residue); and 20 to 30 pounds lime (preferably under 3 per cent MgO). The charging is done so that the coke and lime are mixed with the first third of the charge going on the bottom of the furnace.

The power being on, nothing can be done until the charge is about two-thirds melted, at which time several shovels of a mixture of two parts coke breeze and five parts lime may be added. On melting down, the bath of metal will be covered with a carbide or falling slag, and will have as an average the following analysis:

	Per Cent
Carbon	2.40 to 2.60
Silicon	Practically nil
Sulphur	0.025 to 0.035
Phosphorus	0.05
Manganese	0.65 to 0.68

It will be a well deoxidized metal and, except for discrepancies in analysis and probably temperature, will be ready to pour, being about 0.75 per cent low in carbon and 2 per cent low in silicon. It will be satisfactory in all other respects with the possible exception of the phosphorus.

For an acid furnace, the charge would be exactly the same as for the basic heat, excepting that no lime would be included. Supposing that this heat had been melted in an acid furnace, the analysis of the bath after being brought to a molten condition would be as follows:

	Per Cent
Carbon	2.40 to 2.60
Silicon	0.20 to 0.40
Sulphur	0.05
Phosphorus	0.05
Manganese	0.35

Not much change has taken place in the sulphur or phosphorus, while the carbon is the same as in the basic heat. About 50 per cent of the manganese has gone into the slag, while a small percentage of silicon has been reduced from the slag. In the acid heat, it is necessary to add 0.35 per cent manganese, 0.75 per cent carbon, and 1.60 per cent silicon.

The comparison between the two types of operation has been drawn for the purpose of contrasting the acid and the basic methods, the data being average figures obtained on a number of heats made by both processes. The conditions of the bath in each case are those which would automatically and regularly take place under normal circumstances.

In melting steel scrap under recarbonizing conditions, such as described, the author has found that it is almost inevitably the case, whether the conditions be basic or acid, that the heat will melt down with a carbon content of 2.50 to 2.75 per cent even though a much greater excess of carbon than that given in the charge be introduced into the furnace during the melting operation. To raise the carbon percentage above that point takes a certain amount of time and an extremely hot bath. The absorption of carbon by iron is proportional directly to the time of contact between iron and carbonizing agent, intimacy of contact, and temperature of the iron, and of course, progresses more slowly as the absorption approaches saturation.

With a large excess of highly carbonaceous material floating on the bath, carbon above 2.5 per cent is picked up slowly, even though the temperature of the bath is high. This is probably due to the fact that as the carbon content of iron increases the specific gravity decreases, so that the portions of the bath in contact with the carbonizing material become highly saturated with carbon and tend to remain on top, thus insulating the more poorly carbonized portions of the bath from the carbonizing agent. This tendency is also accentuated by the fact that, in contrast with steel in the electric furnace, cast iron does not boil or circulate to a marked degree.

The author has tried various expedients to accelerate this carbon pick-up, and has found that agitation of the bath is the one on which main reliance can be placed. The bath is brought to a high temperature, slagged bare and clean, and about 50 to 75 pounds of coke per ton of charge are thrown over the bath. The doors are closed to allow the coke to become incandescent. A green pole then is introduced into the bath which is stirred vigorously. The gases distilled from the wood boil the metal violently. One-half per cent of carbon can thus be picked up in 5 to 10 minutes. It is quite frequently necessary to repeat this operation twice, particularly if carbon contents well over 3 per cent are desired.

During this operation a considerable amount of gas is dissolved in the iron, so that sufficient time to allow this to escape should be given the heat before tapping. From the author's experience, the only method of securing carbon contents well over 2.75 per cent is to use a combination of superheated metal, a clean bath, and vigorous agitations for a fairly well sustained period.

The adjustment of the silicon content is a simple matter. The addition is made in the form of 50 per cent ferrosilicon. In the basic furnace, the silicon addition always should be made at the end of the heat, to secure the maximum absorption and minimum loss to the highly basic slag.

In the acid process, a percentage of silicon may be reduced from the slag. Under certain conditions, if the temperature is allowed to get high, the slag highly acid, and the furnace condition highly reducing, a considerable amount of silicon will be reduced from the slag. The action which produces this takes place at a

Paper presented at the general meeting of the American Electrochemical society held recently in Baltimore.

rapid rate, conditions being propitious, and closer analysis may be obtained if this condition be avoided, relying entirely upon ferrosilicon addition.

All three of these conditions mentioned here are necessary to silicon reduction, and by modifying any one of them it can be stopped instantaneously. The simplest method is to introduce a small amount of fireclay or lime immediately under the electrodes. To the operator experienced in acid electric furnace operation, the condition is immediately apparent by several signs, among them being the almost total silence of the arcs, the extreme paucity of fumes around the electrodes, and the general *tightness* of the furnace.

It may be added here, that this condition which comes about in the acid electric furnace is indicative of a highly deoxidized condition of the bath. Tests taken from heats under this furnace condition show the metal to be in excellent condition. Its use, with proper judgment and understanding, therefore, well may be adopted. Some steel foundries regularly allow a heat to come to this condition incipiently before tapping, the results being reflected in the soundness of the castings.

In melting steel scrap by the basic process, practically all of the manganese is retained in the metal throughout the heat. In the hypothetical instance given, no adjustment of the manganese content is necessary. This is a highly advantageous feature of the basic method, except in instances where an exceptionally soft metal is desired. Of course, the heat can be melted first under slightly oxidizing conditions and slagged off, but this method is to be avoided, as it consumes labor, power and slagging material.

If an increment of manganese is necessary it can be added at any time, or even included in the charge. Perfect absorption efficiency can be expected. The manganese will do most good if thrown into the bath immediately after the recarbonization is complete, being a decided help in degasifying the heat.

Manganese Is Lost

In the acid heat, it was noted that about 50 per cent of the manganese was lost, being absorbed in the slag as a silicate, $MnSiO_3$. This manganese is not recoverable to any extent and to all purposes may be considered lost. The addition of ferromanganese to an acid heat should be made just before the heat is tapped, and before doing so, the silicon addition should have been made.

By controlling acidity of the slag and keeping it to about 60 per cent acid, the efficiency of manganese absorption to 85 per cent is possible. Of course it is feasible to make the manganese addition to the ladle, a practice which is favorably considered in many foundries using acid practice on steel. The same considerations hold good in iron. In the practice of increasing manganese content by ladle additions, practically 100 per cent absorption results in gray iron.

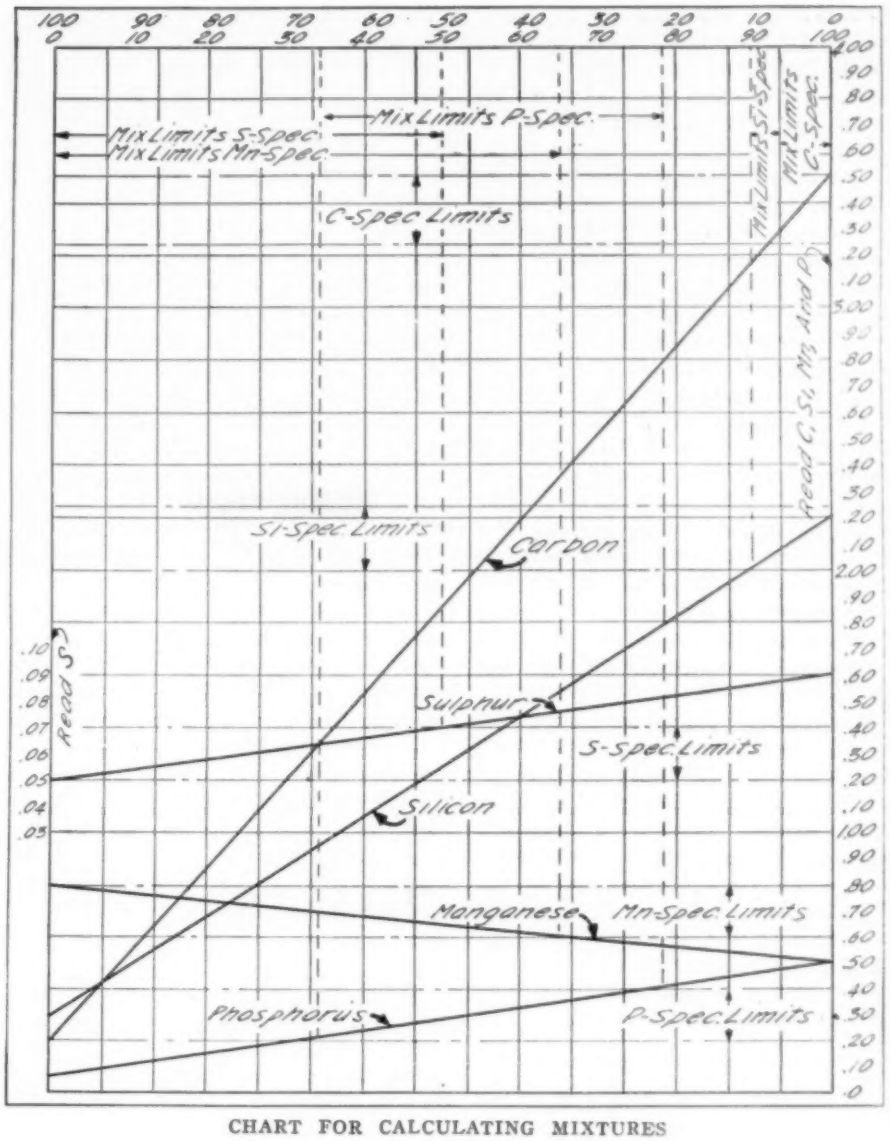


CHART FOR CALCULATING MIXTURES

The author wishes to say that, provided the manganese in synthetic or electric furnace gray iron be sufficiently high to more than fulfill the dictates of the sulphur-manganese proportion, the further addition of manganese does not seem to have a decided effect on the physical characteristics of the metal, particularly with carbon contents of 3.25 per cent or over. With carbon under 3 per cent the hardening and strengthening effect is notable.

With the formation of the slag after the recarbonizing is complete, sulphur reduction will continue. It is pointed out, though, that if coal, or a high-sulphur carbonizing agent be used, a material increase in sulphur may occur. However, this will be eliminated by the carbide slag formed before the metal is tapped, and is not a matter with which to be much concerned.

In the acid process, no decided reduction of sulphur is practicable. The only precaution which can be taken is to make certain that the sulphur is balanced by the necessary amount of manganese. Two or three times the theoretical amount necessray to absorb the sulphur as MnS is sufficient. One foundry making electric gray-iron castings by the acid process, reports an inherent reduction of about 0.01 per cent sulphur on each melting. This is no doubt due to the action of manganese. The resulting MnS is absorbed in the slag. There is no sufficiently stabilized practice as yet to justify depending on this as a means of meeting rigid sulphur specifications.

Keeping Sulphur Low

With respect to sulphur limitations as a feature of synthetic cast iron, it is hardly necessary to give a great deal of attention to the matter if steel scrap be contemplated as the base. The great majority of gray-iron scrap melted is well over 0.07 per cent in sulphur and, in the absence of any pick-up in the sulphur content with electric melting, the demand for 0.05 per cent in castings can be met by melting steel scrap of the proper sulphur content, which undoubtedly will be available for some time to come. Sulphur reduction as a means of gaging the state of

deoxidization is a valuable asset in basic melting of gray iron or in duplexing cupola metal. At least under present conditions, in the synthesis of gray iron from steel scrap, it is believed by the author to be a matter of relative unimportance, at least from an economic standpoint.

The hypothetical analyses applying to the chemistry of the heat after melting is complete, indicates that in neither the acid or basic process is there any great change in the phosphorus content. Phosphorus is rapidly eliminated from iron only under highly oxidizing and strongly basic conditions, at comparatively low temperatures, and not to any marked degree with carbon contents high. It will thus be seen that with furnace conditions recarbonizing and reducing there is no great opportunity of phosphorus reduction in the basic or acid heat. In either case, it will remain constant, finishing with the amount present at the start.

Since the only advantageous function of phosphorus in cast iron is fluidity and that asset is obtained in the electric furnace by a temperature increase, the phosphorus can be materially reduced in synthetic gray iron, thus refining grain structure and decreasing brittleness. Due to the increased expense attendant on phosphorus reduction, it should not be contemplated, even in the event of using percentages of high-phosphorus iron. If phosphorus must be kept low, it should be accomplished by the expedient of using sufficient quantities of low-phosphorus material such as steel, in the charge.

Oxidizing Slag Removed

For the reduction of the low-phosphorus iron, called washed metal, which usually has a phosphorus specification of under 0.03 per cent, and of low-phosphorus pig iron, its elimination should be accomplished by using charges made up entirely of steel scrap, and including two large scoop shovels of mill scale or lump ore per ton of steel, in addition to the lime. It must, of course, be carried on in a basic furnace. The carbonizing material should be left out of the charge, and not introduced until the oxidizing slag is removed.

When melting is completed, the bath is raked clean of slag, and is in a wild condition. The carbon and silicon content will be low, and the recarbonizing material addition should be figured at 60 per cent efficiency of absorption of the contained carbon. When this is thrown on, due to the formation of carbon oxides, a boil in the bath of such violence occurs that the metal will run out of the doors unless checked, causing a sloppy condition of furnace and floor. The effect of the first shovel of carbonizing material should be observed, and if the boil starts, 2 or 3 pounds of ferrosilicon fines, if thrown into the boil, will immediately cause it to subside. This treatment is usually quite sufficient to prevent any further boil, and the work of recarbonizing can be carried on without further danger from this source.

Preliminary Testing

Testing the metal before it is poured is of great importance. The best means, of course, would be chemical analysis, but more often than not, the laboratory facilities are not available. Some method of quickly determining the approximate conditions of the bath is necessary. Color carbon tests would be quite satisfactory, but facilities for making even these usually are not available in the average foundry.

The author has devised a quick testing method, using a brinell testing machine, which was satisfactory for the particular case. A test bar is cast in dry-sand core blocks, the bar being 1 inch in diameter and 6 inches long. The ordinary test spoon holds more than enough metal to pour such a bar. The bar is allowed to stand 3 minutes in the sand and is then allowed to cool seven minutes in air, and immediately afterward is quenched and broken. One side of the fracture is ground and brinelled. If the metal be found above the hardness desired, the carbon or silicon should be raised by additions. If the metal be found too soft, these elements are lowered by the addition of a certain amount of low-carbon steel scrap.

While the name synthetic cast iron was first applied to the process of making iron from charges consisting of steel scrap entirely, it is highly probable that in this country, at least, the charges will generally consist of mixtures of steel scrap and iron borings. Whenever machine shop steel scrap is available, it is more often the case than not, that equal or larger amounts of cast-iron borings are also available. The logical course is to use both grades, since they are frequently mixed and are then priced at the same level.

With such mixed charges, no marked difference in electric furnace operations is encountered. The calculating of the charge is not quite so simple. The author has used a graphic method for figuring charges which simplifies the calculations and eliminates the major portion of them.

The accompanying illustration shows a chart. By marking off the analysis of one grade of scrap on one margin, and doing likewise on the opposite margin or zero-hundred per cent point for the other material, and then connecting the corresponding element points with straight lines, the resulting analysis of any mixture is immediately seen by projecting a line from the percentage scale at the top of the page to the element line. If horizontal lines be drawn, representing the specification limits for each element, it will at once be seen which mixture percentages will fall without the specifications, and how much refining or adjustment for each element is necessary.

The intersection of the specification limit lines and the element lines can be projected to the percentage scale, each pair of these projection lines then representing the limit of mixture percentages which can be used without getting the resulting analysis for each element outside the specification limits. It is also easy to arrive at the mixture point which requires least analysis adjustment or change, by observing the point within the largest number of these vertical limit lines. This charge is quite simple and has proved handy in quickly figuring large numbers of charges from varying materials.

Local and commercial conditions in their relation to available materials, would constitute a determining factor in proportioning charges. Owing to the high silicon and carbon content of cast-iron borings, and the low-sulphur and low-phosphorus contents of steel turnings, mixtures of these two materials, utilizing to the maximum the desirable features of each, give the best economic results, and are consequently to be preferred.

Highly oxidized materials of any sort are to be avoided. The use of such scrap, while not impossible from a physical or chemical standpoint, will not give efficient or economical production, as the additional time introduced in the heat cycle by the unsettling influence and retarding of carbonization runs costs up and output down.

As already stated, commercial availability of materials dictates charge composition. The factor of quality and results desired is one of equal or greater importance, and the relative weight of the two considerations must determine the type of electric furnace operation most desirable and feasible.

Compare Processes

A comparison of the basic and acid processes may be summed up in the statement that the basic process provides facilities for reducing sulphur and phosphorus, while the acid process is lower in costs and is simpler in operation, and acid slag is much easier to handle in casting from lip-pour ladles or shanks. Some fine points, such as the relative deoxidizing ability of the two processes, and the relative freedom from occluded solid impurities in the two irons, are more or less mooted questions.

Removes to Plainville

The Colonial Brass Works, Inc., manufacturer of brass castings, steam fitters and plumbers' supplies, has removed from New Britain, Conn., to Plainville, Conn., where larger foundry facilities are available. R. J. Carlson is president.

Fig. 1—Economical Transportation Is an Important Consideration in a Foundry with Extensive Floor Areas

Study Savings Made by Trucks

INDIRECT labor charges sometimes serve to obstruct foundrymen in their effort to bring down the costs of their product. Many find it possible to introduce saving economy in the molding, melting and cleaning departments, and much of the development in the past few years has been directed toward reducing the labor factor in these branches of production. Improved methods of handling material such as sand, cores, metal, finished castings and waste products also may be made a source of saving if adopted as the result of careful investigation. This furnishes a much more promising field for cost reductions since the advance in wages of unskilled men has placed such a heavy tax upon shovel and wheelbarrow methods.

Yale & Towne Mfg. Co., Stamford, Conn., has manufactured a storage battery truck for a number of years. The units have been adapted to use in terminal haulage, in interplant transportation, where clean floor ways were available, and in service in large warehouses.

Some time ago, the company investigated the possibilities of storage battery truck service in the foundry field, convinced of the need of this industry for some sturdy unit capable of standing the use and abuse characteristic of the casting plant. The company was particularly fortunate in possessing within its own gates the facilities for applying the actual service tests encountered in the various classes of foundries. In connection with its lock, building hardware, chain and hoist, and truck manufacture, this firm operates a gray iron, a steel and a brass foundry, typical in each case of standard modern practice.

Accordingly a number of trucks were placed in service with a view to studying their utility as well as their stamina and economy under the rigors of foundry use. Four units were chosen and their duties specified in such a manner as to as-

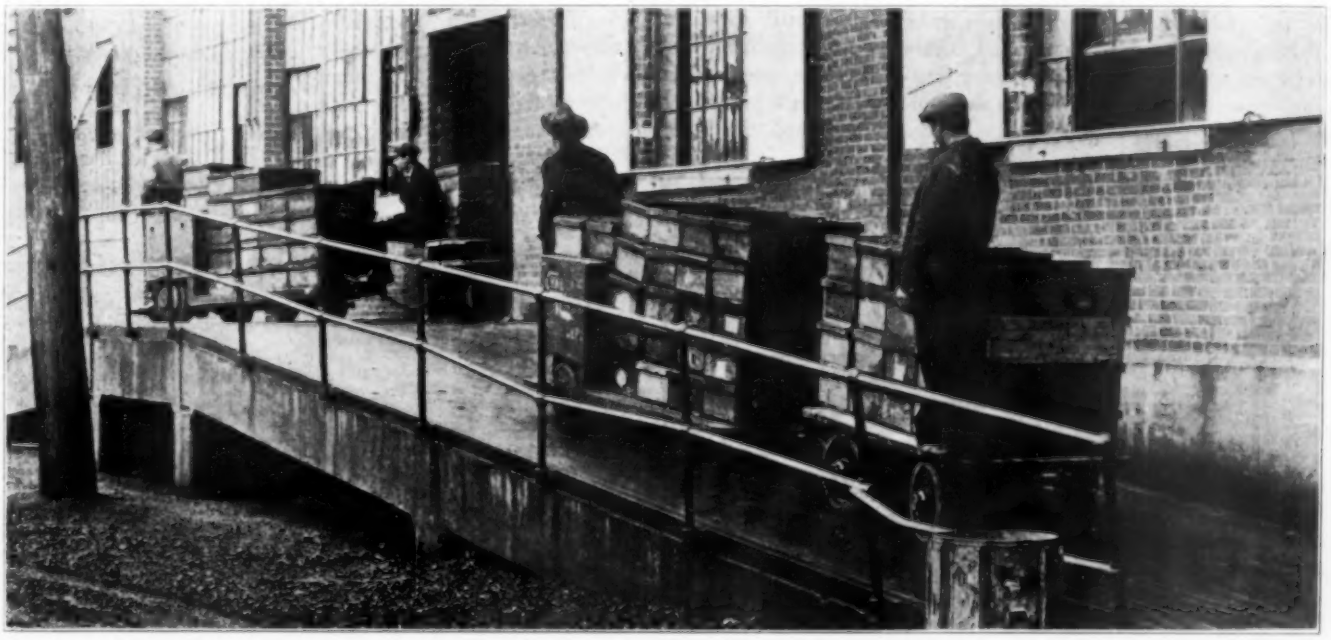
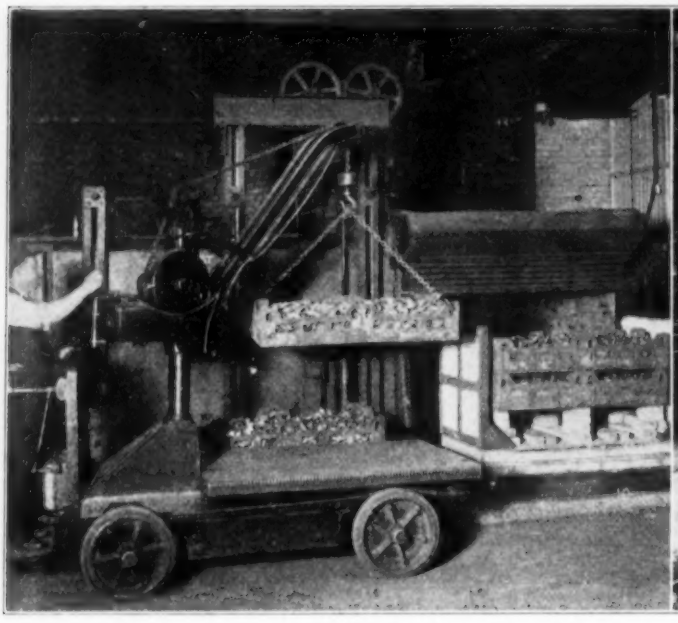


FIG. 2—THE PLATFORM TRUCKS ARE USED WITH OR WITHOUT TRAILERS IN HANDLING CASTINGS, CORES AND MISCELLANEOUS MATERIALS



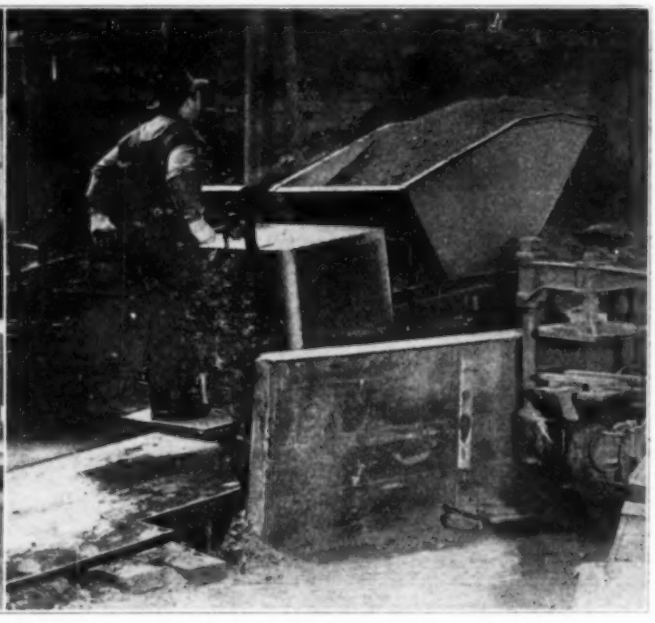


FIG. 3—THE CRANE TRUCK IS SERVICEABLE IN HANDLING TRAYS OF CASTINGS AND HEAVY OBJECTS FIG. 4—BULK MATERIALS SUCH AS SAND ARE CONVEYED IN DUMP BODY TRUCKS

sure them continual operation. Then a careful study was made of the loads handled, length of haul, time elapsed running and time idle, speed, men required and power used. The results of the studies furnish evidence of the way in which trucks may be adapted to foundry service and the manner in which their utility should be studied in contrast with other forms of transportation which require a greater number of men for the same work.

Serves in Foundry

The work of the four trucks was divided to afford, as nearly as possible, continuous service and to cut down the idle time of each unit. One truck with a plain platform, such as is shown in Fig. 2 was appointed to service within the iron foundry. Its work consisted of handling the heavier flasks and other equipment about the floor, delivering miscellaneous supplies to the different molding machine stations, and removing the castings from the sand to the grinding and snagging room, thence to the shipping department. Another service was to supply sand to the sand blast. Late in the afternoon, when the last iron was poured, this truck, hooked by a long chain to a pan under the cupola drop dragged the residue from under the cupola so that it could be wet down, and later removed.

Obviously in this service within the foundry, no long hauls were attained. The average length of run, according to the investigations of the engineering department was 0.032 mile, while some of the trips were only 20 to 30 feet long. Two men were employed in loading and unloading the truck in every instance. One of these men was the driver of the truck. The castings, which in many cases were small lock parts, were handled in metal pans from the foundry floor to the tumbling room and after this in metal tote boxes measuring 9 x 16 x 29 inches. The total weight of the truck with the driver and the helper was 2900 pounds. A study of the service of this truck then was made covering an average 9-hour day. The time was checked by stop watch, the weights accurately taken, the distances measured and the speed and power consumed were carefully checked. The results of the investigation are shown in Table I.

Interesting Features Developed

Many interesting features were developed by this study. The number of trips made in the 9-hour period is given as 49, during which a total of 62,735 pounds of materials were transported. The truck, when loaded, traveled a distance of 2.3 miles.

It may be noted from Table I that the average speed loaded is higher than that recorded when the truck was empty, and that the idle time of the truck is only 81.9 minutes or about 15 per cent of the time elapsed.

A study made over a period of

Table I.

Operating Data on Platform Truck

Number of trips	49	
Load carried	62,735	lbs.
Number of boxes carried	520	
Average load	1,280	lbs.
Miles empty	1.8	miles
Miles loaded	2.3	miles
Total mileage	4.1	miles
Average run empty	0.032	mile
Average run loaded	0.032	mile
Time running empty	61.1	min.
Time running loaded	69.9	min.
Time loading	160.8	min.
Time unloading	166.3	min.
Time idle	81.9	min.
Total time	540.0	min.
Average speed empty	1.8	mi./hr.
Average speed loaded	1.9	mi./hr.
Power consumed empty	880	Watt Hrs.
Power consumed loaded	2,180	Watt Hrs.
Total power consumed	3,060	Watt Hrs.
Average watt hours per ton mile	400	

Taule II.

Operating Data on Dump Trucks

Number of trips	23	
Load carried	57,500	lbs.
Average load	2,500	lbs.
Miles empty	4.9	miles
Miles loaded	3.9	miles
Total mileage	8.8	miles
Average run empty	0.21	mile
Average run loaded	0.17	mile
Time running empty	102.5	min.
Time running loaded	96.2	min.
Time loading	264.0	min.
Time unloading	33.5	min.
Time idle	53.8	min.
Total time	540.0	min.
Average speed empty	2.79	mi./hr.
Average speed loaded	2.7	mi./hr.
Power consumed empty	2,520	Watt Hrs.
Power consumed loaded	2,140	Watt Hrs.
Total power consumed	4,680	Watt Hrs.
Average watt hours per ton mile	244	

month using this same truck, showed the following results:

Number of boxes carried in month	24,433
Average number of boxes per day	977
Weight of the 977 boxes carried per day	122,125

During this longer period the weight handled per day was over twice that reported in the single day's run. The latter does not compare favorably by reason of the time taken in making observations and noting results. It is but fair to assume that the number of trips made in the average day and the distance traveled would show a corresponding increase in keeping with the higher tonnage handled. A similar study might be made in any plant operating industrial trucks to furnish the key for some flat rate or bonus and piece work payment system. This probably would induce a greater efficiency and materially reduce the idle time of the truck.

A truck similar in type to that which previously was studied was attached to the brass foundry of the Yale & Towne company. Its service covered core handling and distribution in both the brass and iron shops, and the removal of all brass castings from the foundry floor to the cleaning department. The cores are made in a fourth floor room adjacent to the brass foundry. They were placed in boxes, carefully packed to prevent breakage and delivered by elevator to the ground floor. Here the boxes were loaded on three specially constructed trailers, provided with a spring-suspended platform, and the truck delivered the boxes to the various molding stations in the brass and iron foundry. The maximum haul distance was approximately 300 yards. Fig. 2, at the left, shows one of the trucks similar to that used in delivering the castings and attached to it is the trailer used for core delivery service. The special spring-platform feature may be noted

Cores on Trailers

It is worthy of note that the cores, some of them the most intricate of small lock cores, were delivered from the fourth floor core room, down the elevator, placed on the trailers and hauled across a comparatively rough foundry yard, over two sets of railroad tracks and into the most remote foundry unit with a minimum of breakage.

No especial effort was made by the Yale & Towne company to build special trackways for its trucks. Within the foundries gangways are made of cast iron plates, as shown in Fig. 1. This facilitated the use of the trucks, and also made a good footway for the men delivering iron to the floors. A third type of truck, similar to that shown in Fig. 3 was used in taking iron and steel castings from the foundry to the annealing room. Annealing boxes of the type shown were used, and the crane picked up the entire box and swung it on the truck to be removed and placed on the oven car. This truck also was used for miscellaneous heavy lifting service about all the foundry departments.

Perhaps the most interesting truck from the standpoint of universal application to foundry work is the fourth unit, a dump body truck used for handling bulk materials. This is shown in Fig. 4. The schedule adapted for this truck was as follows:

7:30 a. m. Supplies molders with molding sand and distributes it from bench to bench.

10 to 11:30 a. m. Carries dirt and refuse from the iron foundry.

11:30 to 12:00 m. Carries clay, etc., to the cupola for daubing.

Entire afternoon. Loads cars with scrap, unloads sand cars, delivers sand to mixers.

Make Time Study

A time study was made of this truck in service in handling sand from the sand shed to the brass foundry, with two men shoveling from the ground level into the dump truck, one man driving and operating the dump body. The weight of the empty truck with the operator was given as 3145 pounds. The time of the truck, given in Table II shows 53.8 minutes idle. This included the time required to install the dump body, all time occupied in making readings and observations and in recording, as well as some minor repairs to test instruments and the meter connections.

The test occupied the same elapsed time, namely a 9-hour day. It may be noted that a total load of 57,500 pounds was handled and the truck traveled a total of 8.8 miles, 3.9 miles loaded and 4.9 miles empty. The results of the test are shown in Table II.

In this service, the truck was operated on practically level ground, but in the normal work of the day, delivery of sand from cars to sand storage required the ascent of a 12 per cent grade with a full load. A comparison of cost made between the wheelbarrow method and the dump truck in handling 600 tons of molding sand from cars to the sand storage bins shows some interesting savings in favor of the more modern form of transportation. The distance traveled from the railway tracks to the sand bin in each case was 400 feet round trip with 40 feet up a 12 per cent grade. The wheelbarrows each handled 5 cubic feet and the truck 27 cubic feet in each trip. The figures given follow:

Wheelbarrow Method

Men required to load	5
Men with wheelbarrows	13
Total number of men in service	18
ment of 600 tons of sand days	6
of sand, days	6
Total cost of labor (9-hour day)	$495.72
Demurrage charges, over 4 days at $25 per day	50.00
Total expense	$545.72

Truck Method

Men required to load	5
Men required to unload and distribute	4
Men required to operate truck	1
	10
Time required to unload 600 tons, days	4
Total cost of labor (9-hour day)	$183.60
Demurrage charges	0.00
Total expense	$183.60

The total savings shown is given as $362.12 or 66 per cent of the cost of the wheelbarrow method of handling. The four trucks are estimated by the engineering department of the Yale & Towne company to save the labor of 22 men, that is 6 men are eliminated in the iron foundry, 4 less are required in constant service in handling sand, 6 less required to handle the work performed by the crane truck, and 6 less in handling the cores and removing the brass castings to the cleaning departments.

Ships Yield Brass Scrap

From the fleet of wooden ships built for war purposes, and now being wrecked at Alexandria, Va., 5000 tons of brass and copper scrap will be obtained in addition to parts containing much brass and copper that will be marketed as second-hand goods, such as pumps, gages, engines, 226 brass condensers, 430 propellers, 226 bronze-mounted cannon for life lines, 1140 miles of electric wire, 522 bronze gongs, and much kitchen ware.

Take Over Chicago Shop

The Mortimer Foundry Co., 2443 West Twenty-first place, Chicago, has taken over the Garden City Foundry Co., 3174 Archer avenue. The Mortimer company, like the Garden City company, has been doing a gray iron foundry jobbing business. It is stated that the operations of the Garden City company will be continued largely unchanged.

Bill Learns To Make Steel Couplers

BY PAT DWYER

SEVERAL of our technical journals recently carried a story to the effect that the management of an East Indian railroad system was contemplating the adoption of American type automatic, single, central, steel couplers on its cars to replace the double bumper, cast iron, link type now in use and patterned after those made in European countries. The story further stated that the total railroad mileage of the country is approximately 50,000 miles and, therefore, the total probable and eventual replacement would involve many thousands of tons of steel castings. The story was of particular interest in that several important American steel foundries specialize in the manufacture of couplers and naturally the prospect of export business with a country that is not in financial difficulties presented possibilities worthy of consideration.

Under ordinary circumstances I would have read the story in the same manner that I read any other piece of foreign news. That is it passes in through one eye and out at the other and in a few minutes I have forgotten all about it. In this particular instance the story made a deeper impression. It shattered all the former conceptions I had entertained on India and dispelled all the hallowed and mystical traditions I had cherished from the days of my youth. This knowledge, I am frank to admit, was based on the writings of that champion old word slinger R. Kipling, Esq., one time resident of the most populous country in the world owing allegiance to the royal crown of England.

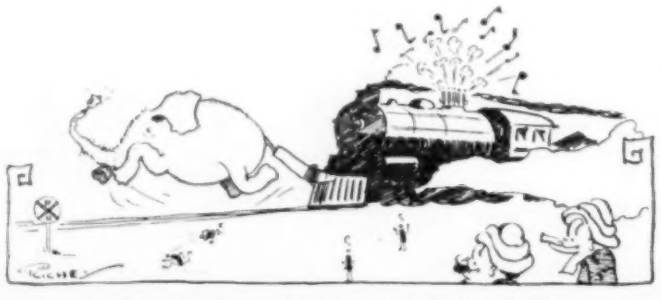
Making all due allowance for the fact that his stories were written many years ago, still I think one is justified in assuming that even in those days, railroads traversed the land. Railroads to the extent of 50,000 miles do not sprout over night even in the tropically prolific climate of India. Mulvaney and his two gallus companions apparently were not aware of this convenient mode of travel. We find them hopping on what Bill is pleased to refer to as their *dogs* over the length and breadth of India. The method was satisfactory in that they never were in a hurry and after they arrived at a definite destination, usually some place with an unpronouncable name, they draped themselves around the camp fire and spent the remainder of the evening in drinking tea from a tin cup, drying their feet and indulging in a profane exchange of light wit and martial repartee.

Mowgli and his free companions knew nothing and if possible cared less for a railroad. Perched on their hunkers they occupied the top of the Council Rock at night, howled at the moon and indulged in other forms of delicate and innocent amusement. To a considerable extent they paid strict attention to their own business, but occasionally at these sprightly council meetings they hatched little schemes that brought them as great a degree of popularity among the other inhabitants of the forest as a modern revenue officer enjoys in the haunts of a band of moonshiners.

Through the pages of the Jungle Book I have rambled all over India in the wet as well as in the dry season. Drenched under a deluge of rain, scorched under the rays of an equatorial sun or blinded by the dust of a screeching monsoon I have enjoyed them all from the depths of a comfortable arm chair. I have seen the country by day and night from the home of the fighting tribes in the far northern hills to the island of Ceylon where the spicy breezes blow; from the ford of Kabul river to the Chinese frontier. Through it all I plodded cheerfully on foot in company with boon companions who never saw a railroad and who probably would die with fright if they saw a locomotive or heard the peculiar hoarse, screaming whistle blast that seems to characterize locomotives the wide world over.

Some day when I become old enough and wealthy enough to afford a hobby I am going to start a movement having for its object the placing of musical whistles on locomotives. The idea, of course, might be amplified to an extent where each locomotive will be provided with a calliope attachment on which the engineer may play a suitable selection on entering each city and town on his line. However, that simply is a detail to be worked out in the leisurely future. At first I should be satisfied with a single pipe, pitched to any note in the natural scale, or possibly a combination of two, three or four pipes of suitably graded diameter and length to produce a harmonic chord.

My recollection of India embraces dust and camel trains, elephants and marching soldiers, temples and palaces, snakes of all degrees of malignity and in sizes that range from that of the tame cobra which acts as a household cat to mighty Kaa of the Jungle Book which used its head as a battering ram in the cold lairs of the forgotten city buried deep in the jungle. I can remember where the Red Dogs fell over the cliff and met their death from the stings of an army of angry bees and in imagination I have followed the adventures of Shere Khan and thrilled with perfectly justifiable pleasure when the heroes of the Council Rock by many a cunning ruse, forced him slinking down the ravine, there to be ground to a pulp under the trampling hoofs and murderous horns of the stampeded buffalo herd. I have heard the paddles chuckin' from Rangoon to Mandalay; but, by the beard of the Prophet, by the virtues of bread and salt and by the snick of a rifle bolt, this is the first time I ever have seen



LOOKS LIKE A BARNUM & BAILEY OUTFIT

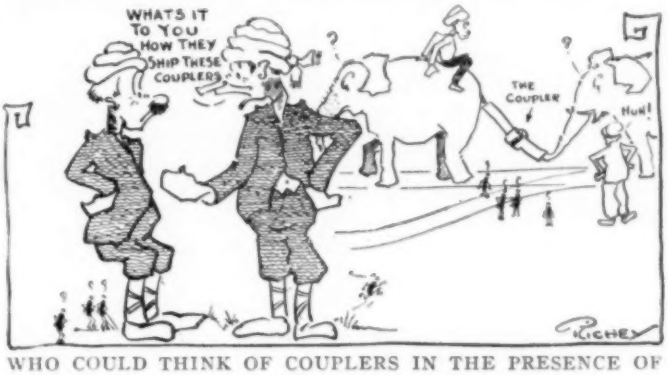
any direct reference to a railroad.

In the olden days I never bothered to verify any of the locations to which Mr. Kipling refers so familiarly. I was perfectly satisfied with the picture his words presented to my mind, and let it go at that. The railroad story piqued my curiosity. I wanted to see where all these thousands of miles of railroads were located. To this end I consulted the GRE-ITA member of a certain family that enjoys an enviable reputation for accuracy, brevity and an entire absence of gush and sentimentality. To say I was shocked at some of the disclosures would be stating the case mildly. From Mr. Kipling's reference to flying fishes, the old flotilla and the sun coming up like thunder outer China 'cross the bay, I had gathered the plausible impression that Mandalay was a seaport town in close proximity to the Celestial Empire. I'll leave it to you if the impression was not justified. You can imagine my surprise, a surprise somewhat analagous to that experienced by a person running upstairs in the dark who finds that he has miscalculated the number of steps and brings his foot down hard on the last step that is not there. When I looked on the map I found that Mandalay is an inland city in upper Burma several hundred miles from the sea and many a long mile from the nearest Chinese frontier. Also I found that Rangoon is on the coast and is situated across the bay from the old Moulmein pagoda in Lower Burma.

Poetic license is a wonderful thing but unless the British soldier came by way of the Pacific on his road to Mandalay, a totally unwarranted assumption, I confess I am at a loss to understand where he saw the sun come up like thunder outer China 'cross the bay. The encyclopedia is a hard combination to beat, but I decided to consult Bill before I wrote Kipling demanding an explanation. To my surprise he displayed no interest in the subject.

"You should worry about Mandalay," he said ironically. "What difference does it make to you where it is? If you were responsible for the shipment of a few thousand tons of steel couplers to Mandalay you might have reason to worry and bite your nails over ways and means to deliver the goods. As it is, forget it and consider for a few minutes the foundry methods involved in the production of the castings. Possibly the contract may be sublet in India, but if so it is quite likely that American methods and American equipment will be employed.

"I worked at one time," said Bill, "in a steel foundry that specialized in the production of coupler castings. The methods in vogue there represented the most advanced ideas both in molding and coremaking, but the feature that served as a never ceasing source of wonder to me was where all the castings went. I presume that conditions varied occasionally over a long period of years, busy and slack times alternated as they do in all foundries, but during the time I was there the two 30-ton open-hearth furnaces ran steadily night and day and melted 120 tons of steel in every 24 hours.

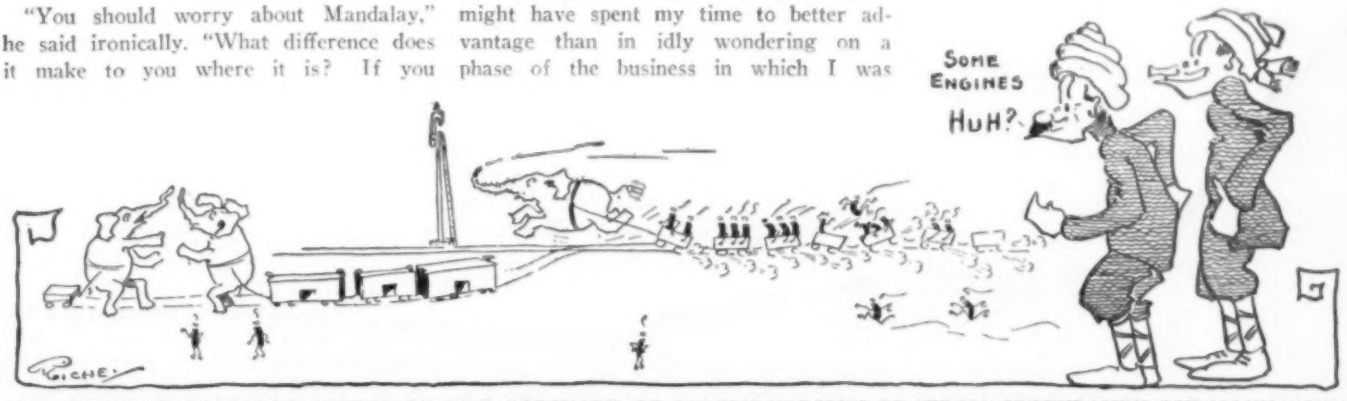


WHO COULD THINK OF COUPLERS IN THE PRESENCE OF SUCH A GORGEOUS BONNET RIBBON?

"The gates and risers on the castings were no larger than those customarily employed in ordinary gray iron practice and I should say offhand did not absorb more than 15 per cent of the metal melted. This left approximately 100 tons of metal poured into castings and believe me 100 tons of couplers will serve to equip a long train of cars. I am willing to admit that probably I might have spent my time to better advantage than in idly wondering on a phase of the business in which I was not directly interested, but taking it by and large I don't think the practice did me any harm. At that time my general stock of knowledge on the railroad situation was rather vague and I did not know whether one million or fifty million cars were floating around on the various railroads. However, I cheerfully assumed that between new cars, replacements and a wreck once in a while, the foundry probably would continue to run full time for the period I felt that I could spare in that particular locality. In passing, you probably may be slightly interested to learn that my expectations were fully met and the old joint was still rolling along at a 120-ton gait 24 hours a day when I finally drew my back time and rambled away in the general direction of a town farther down the line. No, I did not ride the bumpers, but I examined them while temporarily waiting at many of the stations and if I did not see some that I actually had made, I at least saw some of their brothers, cousins and other close relatives. I can't say the recognition was mutual, but that often happens even among human relations.

"Foundries that specialize in one product for any extended period of time are bound to discover and practice short cuts, economical methods and other desirable features to a greater degree that foundries operating on a wide and miscellaneous class of castings. Where the general foundry is inclined to provide a safety factor in the shape of supplies, time and equipment, the specialty foundry knows to the ounce and the minute how close it can skate to the danger point and in that manner is enabled to hug the rail and cut the corners in the industrial race. This foundry I am talking about where they made the couplers, illustrated this point.

"The castings were made two in a flask in green sand molds. Special steel flasks were employed that required no



THIS FEATURE DOES NOT APPEAR IN THE ORDINARY OR SCREEN VERSION OF "FROM GREENLAND'S ICY MOUNTAINS TO INDIA'S CORAL STRAND"

bottom boards on the drags or no bars in the copes. The molds were jolted on machines until the sand was so hard that a man could make no impression on the surface with his finger. The metal entered the casting near the bottom through a single gate and appeared through a single riser about 2 inches diameter situated on the highest point at the other end of the casting. The flask was filled entirely with old sand with the exception of a small quantity of new sand facing in the vicinity of the gate. New sand was employed in some of the smaller cores but the larger cores were made almost in some cases, and entirely in other cases, from old sand. Molders, coremakers and casting cleaners worked all day, but the cores were dried night and day and the furnace and pouring gangs also worked throughout the 24 hours. The castings were poured from a medium low carbon steel, about 0.20 per cent, and were annealed by placing them in an oil-fired reheating oven for approximately three hours and then allowing them to cool on the floor. All the work was on a piece work basis, the men made good wages and the production was unusually high. Take these different features and compare them with the features encountered in the ordinary jobbing shop and you will find the answer to the question why a specialty shop is safe from competition except from others of its own kind.

"The sand was supplied by a well known sand producing company which quarries it in the shape of rock and then crushes, screens, and washes it to varying degrees of fineness. It is crushed and disintegrated in such a manner that the individual grains are separated but not broken and thus the resulting product retains a maximum degree of porosity when packed in a flask. Although the sand is rammed quite hard, the gas and steam escape quite readily and the metal lies quietly against the face of the mold. Analysis of the sand shows a silica content of over 98 per cent which insures that it is sufficiently refractory to withstand the heat of the molten steel without fusing.

"A light coat of silica flour was dusted on some of the large molds but the great majority received no extra protection and yet the castings peeled perfectly clean. The gate in the shape of a core was rammed up with the pattern and located in such a manner that the steel entered the mold near one end, at one side and close to the bottom. This was a much simpler arrangement than the usual horn gate and also was a factor in reducing the depth of the drag required.

"A considerable saving in time on each flask was effected by the elimination of bottom plates on the drags and bars in the copes. The flasks were made in the foundry from a simple design of the superintendent's. Both cope and drag were flanged outside top and bottom but instead of the usual straight walls, each section was bulged out about one inch in the center on both sides and ends. This double tapered construction served to wedge the sand in place and prevented it from falling out of the drags while in transit from the machine to a level bed on the pouring floor. The same construction resisted the upward pressure of the metal in the cope and prevented the sand from rising when the mold was filled with steel.

"Some of the flask parts measured 4 x 2 feet and were 12 inches deep. The first time I saw them I was doubtful if the drags could be handled without a bottom plate and I was quite positive that it would not be safe to pour a mold without either clamping or weighting a plate on the cope. However, in the foundry as elsewhere, seeing is believing, and after I had seen a few hundred castings poured in the flasks I became thoroughly converted and made a solemn vow to introduce this form of flask construction into the first steel foundry intrusted to my care. With certain modifications owing to the density to which the sand must be rammed, the flask might be employed for green sand in an iron foundry. For dry sand molds it should prove ideal.

"I suppose at one time when the foundry was started, all new sand mixed with a little clay had been employed for making the molds and cores. In my time all the sand in the foundry was in good working condition and the only new sand from day to day was in the shape of facing and that was only added in sufficient quantity to replace the sand which adhered to the castings in the shaking out process and which was discarded. The same old sand was used for molds and cores. A little new sand was mixed with the old sand in the facing sand mixture. The great bulk of the cores were made entirely from old sand bonded with a pitch base dry binder and mixed in one of these merry-go-round pan mills.

"The cores were rammed in hand jolt rollover machines and were sprinkled with a diluted liquid core binder before they were placed in the oven. The result was a core with a hard skin and a fairly soft interior.

"Securing foreign orders," said Bill in conclusion, "and filling them may suggest difficult features to some people. After observing the manner in which these coupler people reduced the manufacture of the castings to its simplest elements I don't think they will experience any trouble either in getting the business or in shipping the goods. So far as payment is concerned these same coupler lads have collected bills from customers that have not the commercial rating of the government of India, backed as it is by the crown and dignity of the British Empire and that famous financial institution known as the Old Lady of Threadneedle Street."

British Foundry Exhibition Proposed

The success of the foundry exhibition held in Birmingham, England, in June, 1922, has encouraged the Birmingham chamber of commerce, which initiated and supervised the previous arrangements, to consider holding another next year. To discuss the proposals, the chamber of commerce gave a luncheon on Oct. 25, to which prominent British foundrymen and exhibitors at the previous show were invited. H. Lakin-Smith, the chairman of the exhibition section of the chamber of commerce, presided. Among others, F. J. Cook, Vincent Faulkner and C. Heggie, attended on behalf of the Institute of British Foundrymen. Charles Stanley, manager of the previous exhibition, referred to the success of last years' exhibition and expressed himself strongly in favor of holding one in 1924.

Mr. Cook pointed out that the Institute of British Foundrymen is of the opinion that it is probably too soon to attempt another foundry exhibition in Great Britain, and that at the recent Paris international conference the feeling was expressed that such displays in Europe should not be oftener than once in three years. The chairman assured the meeting that the chamber has no desire to act without the cordial co-operation of the foundrymen's association and the Cast Iron Research association, and they propose to secure, if possible, their co-operation with that of other interested bodies. Stress was laid on the advantage of holding such a show next year in view of the British empire exhibition in London, which it was thought would improve the prospects of success. It also was suggested it would be a good plan to stage the foundry show in connection with the British Industries Fair in May, 1924, at Castle Bronwich about three miles outside of Birmingham. It is understood that on behalf of the chamber of commerce further consultations will be arranged with foundrymen and others interested with a view to securing joint action.

Manville Jenckes Co., Pawtucket, R. I., formerly operator of an iron foundry at West Bridgewater, Mass., under the name of the West Bridgewater Foundry Co., has discontinued that business and is offering the plant for sale.

Applies Standard Time System

Opportunity To Increase Earnings

Workmen Assured of Hourly Rate

FAIRNESS is an essential in maintaining harmonious relations where one human being has dealings with another. Of course, fairness is a relative quality and that which is considered fair in one age perhaps is considered unjust in a later age when a higher sense of justice has been attained. Therefore, the term *fairness* can be used only in a relative sense, and as such requires a spirit of toleration on both sides. First, an agreement must be reached as to what is fair and then a means of carrying out and maintaining this standard under every condition must be established.

Probably one of the best examples in which a standard of fairness has been established is shown in the baseball leagues throughout the country. Here, rules of playing the game have been worked out gradually to prevent either side from securing an unfair advantage over the other. A system of umpiring has been built, surrounded by strict rules and regulations to prevent pressure being exerted to cause the umpire to favor either contestant. In this field everything has plainly been conducive to fairness. The public which supports the leagues wants to see a clean game, and is so insistent on this that if unfair decisions are made trouble is started.

Each Wants to Be Fair

On the other hand, the manufacturer and his workmen must decide their problems by themselves. Basicly each probably wants to be fair to the other, but two things stand in the way. The viewpoint of the two sides are diametrically opposed. A means of arriving at and operating a system, under all conditions to afford a fair deal for all concerned is difficult. Arriving at a common viewpoint is hindered by suspicion engendered through past experience and from a desire of each side to gain more than the other side considers fair.

In the past, if the employer secured a firm hold on the management of the company's affairs and held the workmen to the scratch, things went along quietly as long as the employer did not bear down too hard on the workman. On the other hand combinations of workmen sometimes gained almost despotic control of a company and if not used in too high handed a mannner this system worked for a time. However, in the present state of industrial affairs any system which does not give both sides opportunity to discuss the situation and advance plans for mutual agreement eventually will terminate in trouble. This fact is generally realized, but few firms have been able to advance a system particularly as concerns payment or wages which is whole-heartedly accepted and agreed to by the workmen. For this reason the plan of shop committees to consider problems of management affecting the worker, the advancement of the workman's and company's interests, and the standard time system that has been established by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is of interest to employers and to employes alike.

This system embraces all operating branches of the company, which has a wide variety of work in different parts of the country. It will be well to get an idea of the system as applied to the big works in East Pittsburgh, with its nearly 20,000 employes, before studying the system in the foundries.

A notice was posted at the East Pittsburgh works, Jan. 8, 1919. This stated the company's intention to formulate a plan whereby the more important matters which affect the employes in general would have mutual discussion prior to the final decision by the management. To accomplish this, eleven shop representatives were elected by the vote of all employes working on a check, which included all mechanics and day laborers; in fact, all employes except clerks, engineers, foremen and executives. At a meeting of these shop representatives, held July 28, 1919, a committee of three shop representatives was appointed to draft a recommendation for enlarging upon the plan of shop representation The recommendations of this committee were submitted at a meeting of the representatives of the shop and of the management, held Aug. 2, 1919. The plan was slightly modified and put into effect. By the rules adopted, the plan was broadened to include the clerical force. Probably the ideal way would be to have every employe in direct touch with the management, but this obviously would be a physical impossibility, at least to the extent of taking direct part in discussing all matters of general interest to the employes. However, to have each employe in touch with the situation, departmental committees are elected by the employes, paid hourly rates according to the number of persons in the department. The management has representation on these committees of not more than the workers. It is provided that the head of the department and at least one other member of the supervisory force be appointed on each committee, but the management seldom appoints its full quota. These committees have jurisdiction over affairs incidental to their respective departments alone.

Forms Supervisory Force

The factory clerks elect one member from each of thirteen districts into which the plant is divided. The representatives from the clerical department and the members of the departmental committees form the works joint conference committee. This committee elects twelve of its members, who, with an equal or less number appointed by the management from the supervisory or managerial forces, and with a member elected from the factory clerks committee, constitute the executive committee. All matters which cannot be settled by the departmental committees or by the joint conference committee come before the executive committee.

The rules provide for regular meetings of the several committees and the time of their election. Eligibility for voting and the method of counting the ballots also are specified. All employes on an hourly payment, both men and women, are eligible to vote, except members of the supervisory force and those employes who have authority to hire for, or to discharge from, their departments. This is one of the precautions taken to prevent any form of co-

ercion being used upon the voters. A precaution taken in the company's interest is a provision that a candidate to be eligible for election to the departmental joint committee must have been in the employ of the company for at lest two years. However, under no consideration does the company interfere with elections held according to the rules laid down, and any department head or foreman who would attempt to influence an election would be summarily dealt with by the company.

Have Free Hand in Election

As may be noted from these rules, the employes have a free hand in the election, and the one receiving the highest number of votes is declared elected with nothing to bar him or her except the two limitations of time of service with the company and having supervisory or hiring authority, as already noted.

As a precaution to insure fairness in its dealings with its employes, the wage rate of every individual in the company is reviewed twice every year, and his recommendations for an increase are carefully considered.

The standard time system prevails in all of the foundries of the Westinghouse company with slight modifications to meet the peculiar requirements of each shop. A clear idea of its application may be obtained from a study of the system as it is operated at the big foundry at Trafford, Pa., a few miles east of the main plant of the Westinghouse company. This shop, in which both gray iron and steel castings are made, is fitted to produce heavy work, and has a wide variety of output with little repetition work.

One committee functions for the entire foundry, instead of a number of committees as in the main works with its thousands of employes. The committee is composed of one representative and an alternate from each of the five departments; molding, coremaking, pattern making, and electrical repair including the miscelleaneous smaller departments. The company is represented on the committee by A. Slusser, works manager; J. R. Thompson, assistant works manager and C. Somerholder, head of the rate department, for foundry miscellaneous work, and H. Chappell for patternwork. All grievances, recommendations for betterment of working conditions or for improving methods, and general wage questions are brought before this committee. So far no question has come before the committee which has not been amicably adjusted, but should a condition arise where a point could not be decided by the committee it would be carried for final decision to H. P. Davis, vice president of the company who has charge of operations. However, as each question coming up has been so readily adjusted by the committee, confidence in the ability of the committee to solve any problem put to it has gradually increased, and a realization of the desire for fairness all around has been gained.

Elections are held regularly and the company feels it is of advantage to have new members on the committee occasionally as the experience of the committee work gives the members a better understanding of the problems of the company. Naturally then, the more men who get experience on the committee the better the motives of the company will be understood as each member will talk to his friends and followers about the affairs which come before the committee.

The problems of the individual as well as the collective problems of the shop are dealt with by the committee and any workman who cannot settle a difference with his foreman can bring the question before the committee. This has a tendency to make both the foremen and the workmen more careful in their dealings with each other and the committee has few questions to settle for individuals.

Wages and rate of pay are probably the greatest sources of contention in manufacturing establishments. These questions are not eliminated at the Westinghouse company, but the standard time system which has been adopted greatly reduces the number and the seriousness of such questions.

Has Time Specified

In the standard time system each job has a definite time specified for its completion. All workmen receive a set guaranteed wage. This wage carries an increased rate termed the standard time rate. If a workman does not do a job in the time allowed for it he receives his regular hourly guaranteed rate and looses nothing except the increased pay at the standard time rate which either he did not try to earn or was unable to through lack of skill. However, it is rare that a workman who has been broken in to his class of work fails to finish a job in less than the standard time as the rate is set so that a reasonably able workman can finish the job in less than the standard time. In such a case he gets paid for the time allowed instead of for the number of hours which he actually works. Thus if 100 hours is allowed for the job and the workman finishes in 80 hours he gets paid for 100 hours at the standard time rate and has the extra 20 hours to work on another job.

To set the time for a job a study is made of conditions. If an individual casting is to be made, records which cover a number of years are consulted and a fair time can easily be determined from what previously has been done. The actual time in which the casting previously was made is not necessarily taken, but it forms a guide for estimating the time in which the casting should be made, taking into consideration the equipment and any changed conditions in the foundry. If the same casting has never been made in the shop, a close estimate as what should be expected can be obtained by consulting the records for similar casting. On long repetition jobs, of which few are received by the foundry, the rate can be set by the records of previous jobs.

Consults His Foreman

Every rate is set finally by the head of the rate department and the workman knows before he starts on a job how many hours have been set for it. If he thinks the time is too short he consults with his foreman who goes over the job with him. If he still thinks he was right in his estimate of the job the head of the rate department is called and explains how he estimated the job. His say is not final for if the workman is not convinced by the explanation the works manager is called. The molder, the foreman, the head of the rate department, and the works manager *build up* the job. That is, they go over each step in the operation of making a mold and total up the time estimated for each step. In this way a fair rate usually is determined, for with the averages of time estimated by each of the four men well acquainted with the problems of molding, a time can be agreed upon for the individual steps and then the total will necessarily be in accord. Cases like the one just considered are exceedingly rare for the molder usually is convinced after the rate setter has explained the method by which he arrived at his estimate, or if after consulting with the molder he sees that his estimate has been too low he increases the time allowance.

Once a standard time has been set on a job it is not changed unless different rigging is provided which enables the job to be made in a shorter time. This rule gives the workman confidence that he can work as fast as he wishes without danger of having the time allowed on the job reduced. One of the big benefits from the system is that an adjustment of wages can be made without changing the time allowance. If, as in the case of the recent depresssion it is found necessary to reduce wages the wages are reduced but the time allowance remains the same. Then as it becomes possible to increase wages with better business the wage increase in no way affects the time allow-

ances for making the individual jobs.

Among the advantages accruing to the men from this system is an ability to earn larger wages than is possible under the hourly system, and to be sure of a wage not less than the hourly wage, which is not always the case when a straight piece rate system is in vogue. The gain to the company from increased production is a lowering of overhead through more production from the same space and equipment. The way the molders get after the crane when it is needed is an illustration of one avenue for increased production. When working on an hourly rate the molder felt it was up to the foreman to see that the crane was available when required and did not make any great effort to secure it. With the standard time system, he plans his work so that he can do as much as possible when he secures the crane, and when he does have to wait he finds something else to do instead of waiting for the crane. Also, he realizes that the other molders are in the same situation as he is and releases the crane as quickly as possible. Then, when several men are working on the same job each knows that any slacking on his part will be noticed by the others, and he is inclined to do his best. It also is felt that the foundry loss is lower because the molders do not get paid more than the hourly rate when a casting is lost through defective molding. Thus, if a casting with a standard time of 100 hours is finished in 80 hours the molder gets paid for 100 hours work at his standard time rate, if the casting is good. However, if the casting is defective due to molding conditions under the control of the molder he will get paid only for the 80 hours which he actually worked at his regular hourly rate. Naturally this factor induces him to be more careful.

It seems strange on the face of it that while all jobs have standard time set for them, the molders are not paid the same hourly wages. Then if a 100-hour job is given to a molder whose guaranteed rate is 80 cents an hour and his standard time rate is 88 cents an hour he gets $88.00 if he finishes it in 100 hours or less, while if the same job is given to a molder whose guaranteed rate is 70 cents an hour and his standard time rate is 77 cents an hour and he finishes it in the same time as the higher paid molder he gets only $77.00. The explanation of this is that the more difficult jobs are given to the higher paid molders and as a molder shows his ability to handle the more difficult work his wage rate is increased to conform to the class of work he can handle. Then it is the foreman's place to see that the higher paid men are given the more difficult jobs, and skill is rewarded not only by the extra pay which can be made by finishing the job in a time less than the standard time, but by higher wages.

This higher earning ranges from only slightly over the guaranteed hourly rate to 50 per cent or more above the guaranteed hourly rate. In March a molder whose hourly rate was 75 cents made an average of 95½ cents an hour. The first of April his hourly rate was raised to 80 cents but the standard time on the job was not changed. With this increase in the guaranteed hourly pay rate he was able to make an average of $1.14 an hour during April.

Chippers are able to increase their pay even more than molders as there seems to be a greater variation in the ability of the men to speed their work when chipping than when molding. One chipper whose hourly rate in March was 45 cents an hour averaged 68¼ cents an hour during the month. In April his hourly rate was increased to 51 cents an hour and he averaged 72 an hour during the month. With these inducements it is natural that the workmen should desire to work on the standard time system.

Although it is impossible to put every job on the standard time system, the company endeavors to have as much work as possible done by this system. An example of the effort made to place work on the standard time system is shown by the plan to put the mixing of sand on this system. A certain time is allowed for each box of sand mixed and delivered to the floor. The boxes, or skips, are large, holding 1200 pounds The facing sand is mixed in a machine built by the National Engineering Co., Chicago and the core sand is mixed in a mixer made by the Standard Sand & Machine Co., Cleveland, the sand being carried to the floors by cranes.

Requires Extra Clerical Work

In both cases three men work on the job, each having a different rate of hourly pay. Thus the extra pay for each man must be figured separately. This makes extra clerical work, but even more extra clerical work is caused when a molding job is given out in which a molder with one or two helpers and a laborer or two are required. In such a case a certain number of hours are allowed for molding and for helping. Naturally a helper does not want to lose any time. Therefore, if the job reaches a stage where the helper does not have anything else to do he is sent to another job and his proportional time must be calculated on each job, giving him the benefit of the time saved over the standard time. This adds complications not only in the cost and time departments but in the payroll department. To avoid controversy from misunderstandings about the amount of pay received, slips showing the amount of pay due are given to each man before pay day, so that he has time before he receives his pay envelope to make complaint in regard to any discrepancy in the amount of pay indicated on the slip and the amount he thinks he should receive. Thus all questions in regard to the amount of pay due are settled before the pay envelope is received and the amount in the envelope is always correct.

To care for the added clerical work required by the standard time system, a force of from 4 to 5 extra clerks are required, but the company feels this expense is small compared to the saving accomplished by the operation of the system. An idea of the size of the shop and the scope of work done will give a clearer understanding of the flexibility of the standard time system.

Both gray iron and steel castings are made as previously has been noted, the gray iron foundry averaging 1400 tons of castings a month and the steel foundry 250 tons. In the iron foundry large generator frames and motor frames, together with bed plates and other large and medium size castings for electrical equipment are made, the time limit on some casting reaching as high as 1000 hours. The steel foundry has even less repetition work than the gray iron foundry, making turbine castings including throttle valves, nozzle blocks, high pressure steam pipe, etc., together with other miscellaneous steel castings used by the company.

The foundry building is 606 feet long by 180 feet wide, and consists of a large central bay, 80 feet wide, with monitor roof and a 50-foot side bay on each side. The center bay is served by one 100-ton crane, two 60-ton cranes, and 6 jib cranes. All the heavy molding and pouring is done in this bay. The steel foundry with its 6-ton Lullum electric melting furnace is located in one of the side bays which is served by two 20-ton cranes. The melting furnaces for the iron foundry also are located in the side bays. This equipment consists of a 40-ton air furnace in which metal is melted for the heaviest work where it would require too long a time to collect the metal from the cupolas; also two cupolas lined to 82-inch inside diameter, one lined to 60 inches inside diameter, and one lined to 48-inch diameter. Another cupola lined to 36 inches is located in a small foundry 40 x 150 feet, adjacent to the main shop, and equipped for light work. The cupolas and air furnace in the main foundry are located so that the metal may be tapped from them into ladles held by cranes in the center bay.

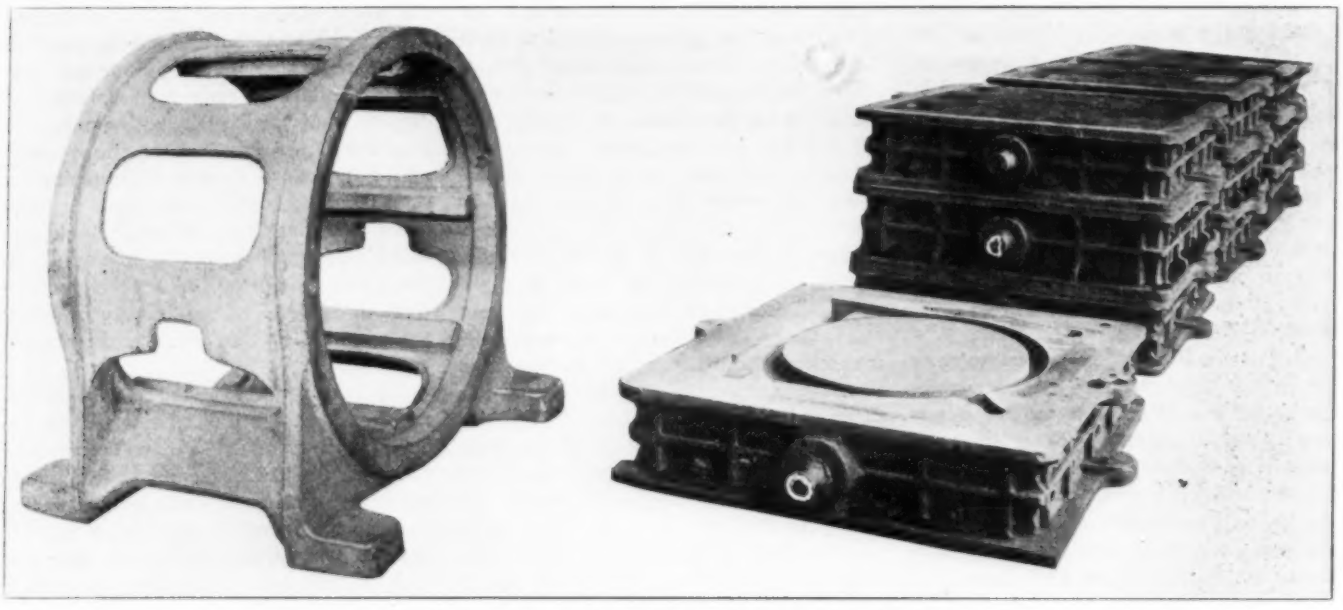


Fig. 1—Frames are free from fins Fig. 2—Drag flask ready for cheek

Special Rig Molds Generator Frames

ONE of the repetition jobs for which the Trafford foundry of the Westinghouse Electric & Mfg. Co. has designed unique molding equipment is the production of small generator frame castings. The apparatus which was built in the shops of the Westinghouse company is intended to cut down the cost of making the casting and still allow the molder to make a good wage. The use of dry-sand cores is avoided and the casting comes from the mold free from fins, which reduces the time required for cleaning and gives a better looking casting.

As indicated in Fig. 3, the equipment consists of a plain jar-ram stripping plate machine with the apparatus, shown above, for stripping the upper section of the pattern. This illustration shows the pattern and flask for the cheek on the molding machine. This is the main section of the mold, the cope and drag each forming part of the rim and two feet. An idea of the molding problem may be gained from Fig. 1 which shows the finished casting. The rim and feet at each end may be seen clearly.

Before shoveling sand in the flask, Fig. 3, a carrying plate for the core is set in the center on the bed of the machine and a wood plug is placed over the center of the carrying plate. After the sand is shoveled into the flask and jolt-rammed and struck off the stripping plate equipment shown above, Fig. 3, is set on the flask by a crane. It is centered by two bolts which fit into the two lugs on the sides of the flask. One of the bolts is indicated at *A*, Fig. 3. When the mechanism is centered on the flask, the head, *H*, to which three arms are attached is dropped on the pattern. This is quickly accomplished by a few turns of the hand wheel *C*, which releases the thread on the shaft through a slip seat arrangement. Then after three screws, one at the end of each arm, as indicated at *B*, Fig. 3, are attached to the pattern, it is drawn by turning the hand wheel *C*, the heavy hub guiding it straight.

After the top half of the pattern has been drawn, the lower half is stripped through the bedplate of the machine by operating the levers shown in Fig. 5. This illustration shows the flask prepared for lifting from the machine. After the pattern is drawn, the plug in the center of the mold is taken out, the yoke

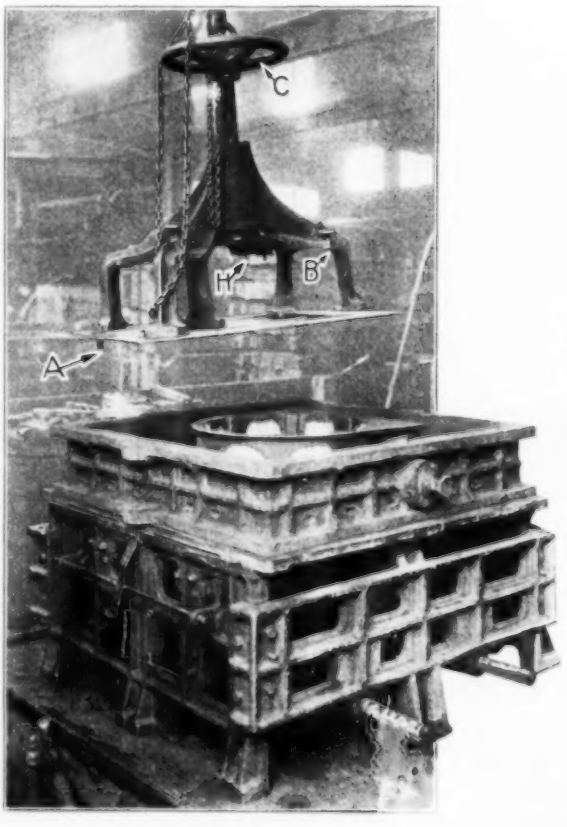


FIG. 3—THE UPPER HALF OF THE PATTERN IS STRIPPED WITH THE AID OF THE EQUIPMENT SHOWN SUSPENDED ABOVE—THE LOWER HALF IS DRAWN THROUGH THE BED OF THE MACHINE

set across the face of the mold, and the rod *E* screwed into the carrying plate. the hole in which is kept free from sand by the wood plug. Broad, flat pieces of wood are placed under the yoke and between the core and the mold to prevent the core from tilting when the mold is lifted from the machine by the crane The screw adjustment on the rod above the cope tightens the core to the yoke.

The cope and the drag are made from the same pattern, the only difference being in the gate and risers. The cope is arranged with a hole for the down gate and for two risers, one over each of the two feet of the casting in the upper section of the mold. Fig. 2 shows a drag ready for the cheek. As may be noted, no bottom board is used. The mold is barred in such a manner that it can be set on two rails imbedded in the floor. These rails, when struck off, furnish a level bed for the drag.

Fig. 4 shows a cheek placed on a drag. These cheeks vary in height from 8 inches to 18 inches, but this difference requires no change in the apparatus, a different cheek flask being the only variation required for the various patterns.

Book Review

Self Taught Mechanical Drawing and Elementary Machine Design; by F. L. Sylvester, M. E., with additions by Erik Oberg and C. W. Reinhardt; cloth, 345 pages including a 7-page index, 7 x 5 inches; published by the Norman W. Henley Publishing Co., 2 West Forty-fifth street, New York and supplied by THE FOUNDRY for $2.50 net.

The third edition of this work has been revised and amplified to bring it into line with the latest development in modern practice. Several chapters have been added by Eric Oberg, associate editor of *Machinery* and others have been added by C. W. Reinhardt on the subject of technique of mechanical drawing and freehand lettering for working drawings. The present volume has been prepared to meet the needs of the student whose previous theoretical knowledge is limited and is in effect an elementary treatise on mechanical drawing including the first principles of machine design. The treatise has been adapted to the requirements of practical mechanics and young draftsmen and is presented in a clear and concise manner to make self study easy. Practically all the elements of machine design have been considered, algebraic formulas are explained and the elements of trigonometry have been treated in a manner suited to the needs of practical men.

The material has been arranged in a manner that will lead the student logically from the simple exercises illustrating the use of lines through a series of steps that represent a continuous course of study that culminates in a consideration of the elements entering into machine design.

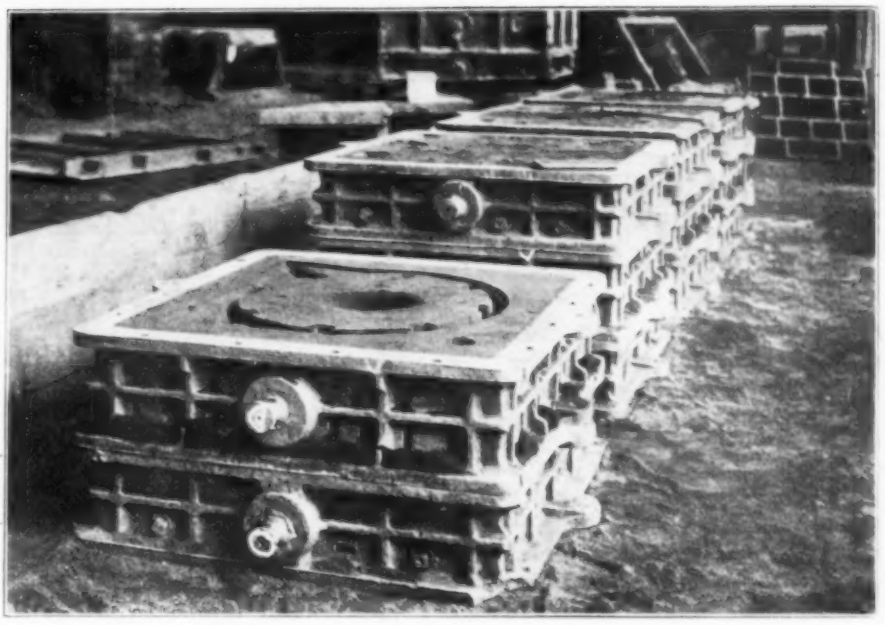


FIG. 5—CHEEK ON A DRAG IS SHOWN IN THE FOREGROUND AND COMPLETED MOLDS MAY BE SEEN BEHIND IT

Data on Trademarks

The department of commerce has issued trade information bulletin No. 155 on the subject of trademark protection in Europe. All information is given concerning the trademark requirements in different European countries, and the cautions to be observed in protecting American trademarks abroad.

The Mond Nickel Company, Ltd., London, England, have purchased the minority stock previously held by the Charles T. Hennig and G. P. Bassett Jr., and now are the sole owners of the American Nickel Corporation, Clearfield, Penn., manufacturers of 99 per cent pure malleable nickel.

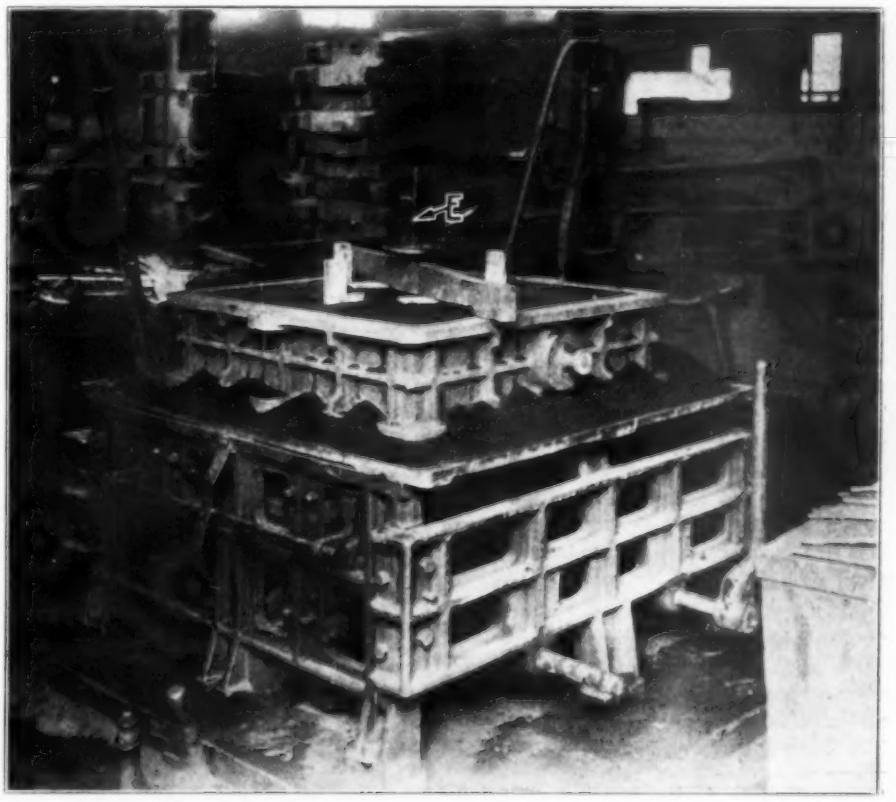


FIG. 4—CHEEK FLASK READY TO BE LIFTED FROM THE MACHINE—THE CENTER CORE IS SUPPORTED BY A LIFTING PLATE

Metals Must Resist Corrosion

Pumps in Mines Handling Acidified Waters Require Special Metals—Alloys Should Be Free from Zinc—Tests Under Working Conditions Give Different Results from Those Made in the Laboratory

BY G. A. DRYSDALE

THE most important problems involved in the manufacture and selection of a satisfactory mine pump, outside of its simplicity of design and efficiency, are the resistive and other principal properties of the metals used, for the reason that a mine pump is subjected to more severe conditions than an ordinary pump above surface, and also because of the extremely bad water which, in the majority of cases, such a pump has to handle. Consequently the author has gone carefully into this matter to ascertain the relative values of different metals and alloys for this purpose.

These physical properties are almost entirely controlled by the methods employed and conditions under which such metals or alloys are produced; that is, whether they are rolled and drawn, drop forged, or cast. In any of these cases the product varies in structure and consequently in strength and resistance to penetration, though the constituents of the alloys are the same. For example, all the metals and alloys that are rolled and drawn or drop forged, are more highly resistant to the attack of corrosion and erosion of mine water than similar metals and alloys when cast. In the first instance the structure of the metal is designated as dense or fibrous and uniform, and in the latter as granular and ofttimes crystalline and irregular. This latter condition can be overcome to a great degree by casting the same under pressure, but this materially adds to the cost, and, from a foundry standpoint, is oftimes impracticable. It is also for this reason that metals and alloys which are not classed as acid resisting, but give a close uniform structure, often give more satisfactory results in a mine than highly acid resisting metals or alloys which have a tendency toward segregation and crystallization, thus permitting free penetration, and consequently are more easily attacked by corrosion.

As an example of the vast difference in the physical and resistive properties under such conditions, we note two samples of a copper-base alloy with nickel and zinc in exactly the same proportions. The sample designated as *A* was rolled and drawn, and *B* was cast in the usual way, giving the following physical properties:

	A	*B*
Yield point—pounds per square inch	52,500	.....
Tensile strength—pounds per square inch	70,750	30,850
Elongation—per cent in 2 inches	15.50	2.50
Reduction in area—per cent	25.81	.....

These two samples were machined down so as to give the same surface exposure and placed in running mine water for corrosion test, covering a period of 90 days, with the following results:

Sample *A* lost 3.15 per cent.
Sample *B* lost 12.70 per cent.

These conditions have been noted in a number of alloys of different composition, with similar results.

Table I gives the comparative resistive properties of a few of the metals and alloys most frequently used for mine pumps, and also a comparison of the same when rolled and drawn, and when cast according to the usual method of procedure in the average brass foundry without the use of heavy risers, etc. The surface exposure of these samples was approximately the same, and the test was made in running mine water giving the following analysis.

Free acid as sulphuric, 91.6 grains per gallon.

Mineral matter—total solids, 479 grains per gallon.

It may be noted from the list shown in Table I that the rolled and drawn high-chromium steel, and the cast lead-base metal designated as *M*-3, also the cast high-silicon iron, are the most highly resistant to the action of this particular mine water, which is considered hard to contend with. The other metals given in the list could not remain in serviceable condition in a pump for any reasonable period of time, and their use consequently involves heavy renewal expense.

In considering acid resisting metals or alloys in general, and more especially those which heretofore have been used for mine pumps, it is found that some of them cannot be rolled and drawn, and others cannot be cast with economy, and, therefore, their production becomes an expensive problem. Consequently up to the present time no satisfactory mine pump has been made of one acid resisting metal.

Owing to the extremely low physical properties of the cast high-silicon iron, it cannot be considered a suitable metal for some castings used in mine pumps.

The high physical properties obtained with the high-chromium steel render it a good metal for shafting, bolts, nuts, etc. This high-chromium steel is obtainable under various trade names, but of the number of samples of such metals received and tested by the author, few were found to be truly acid resisting. For this reason thorough test must be made to determine the actual value of a specific brand of such steel before the same can be relied upon for use in mine pumps, or to resist the corrosive action of mine water.

The lead-base alloys as a general rule,

Table I

Comparative Resistive Properties

Description of metal or alloy	Base	No. of days immersed	Per cent loss
Meco—rolled and drawn	Copper	30	1.65
Meco—cast	Copper	30	3.73
Monel—rolled and drawn	Nickel	30	0.95
Monel—cast	Nickel	30	3.20
Brass—rolled and drawn	Copper	30	1.75
Brass—cast	Copper	30	5.20
Bronze A—rolled and drawn	Copper	30	1.38
Bronze A—cast	Copper	30	4.75
Bronze B—rolled and drawn	Copper	30	1.80
Bronze B—cast	Copper	30	5.60
M-3 metal—cast	Lead	30	0.13
14 per cent silicon iron-cast		30	0.014
High-chromium steel—rolled and drawn		30	nil
Cast iron—close grained		30	22.42

The author, G. A. Drysdale, is metallurgical engineer, the Midwest Engine Corp., Indianapolis, Ind.

Table II.

Tests of High Chromium Steel

Metal	Days of test	Per cent loss	Remarks
Stainless steel *A*	9	15.676	
Stainless steel *A*	27	55.335	Test discontinued
Stainless steel *B*	21	0.039	
Stainless steel *B*	30	0.024	
Stainless steel *B*	30	0.025	
Stainless steel *B*	30	Nil	
Total	111	0.088	
Stainless steel *C*	30	0.049	
Stainless steel *C*	30	0.046	
Total	60	0.095	
Stainless steel *D*	10	0.467	
Stainless steel *D*	30	1.915	
Total	40	2.382	
Stainless steel *E*	10	0.231	
Stainless steel *E*	30	1.191	
Total	40	1.422	
Tobin bronze (rolled)	26	47.371	Test discontinued
Tool steel (18 per cent tungsten)	16	42.516	Test discontinued
M-3 metal (cast)	10	0.458	
M-3 metal	30	0.897	
Total	40	1.355	

have rather low physical properties, and the higher the lead content the lower these physical properties will be, and vice versa, but lead-base alloys can be made to give sufficiently high physical properties, and being a good foundry proposition, would be suitable for castings for a mine pump. Such a combination of a good lead-base alloy and a suitable high-chromium steel has provided a satisfactory mine pump.

As an insight into the varied results obtained in testing a number of brands of high-chromium steel, the following description of the tests are given and their results are shown in Table II. The samples of five different brands of *stainless* steel were submitted to the author for test purposes, and the first test was to determine their resistive properties in mine water. To make these tests as uniform as possible nuts of exactly the same size were obtained from the samples, and used in exactly the same manner; that is, to screw onto the shaft that holds the impeller in place in a 1-inch single suction centrifugal pump. This exposed the sample for a definite period of time to the mine water at the intake pipe, thus subjecting it to the most vigorous corrosive and erosive action of the mine water.

The steels designated as *B* and *C*, Table II, demonstrate that they are highly resistant to the erosive and corrosive action of mine water. Samples *D* and *E* were not so highly resistant in this instance, and sample designated as *A* was a complete failure for such a purpose. The high-speed tool steel (18 per cent tungsten) and the tobin bronze are given for the purpose of comparison; and the lead-base cast metal *M*-3 is used as a comparison of high acid resisting properties.

Samples of these five different brands of stainless steel were obtained in the form of discs, of approximately the same weight and surface exposure, and immersed for definite periods of time at a room temperature in 1 per cent, 10 per cent and 30 per cent solution of sulphuric acid, with the results as shown in Table III. Sample *B* stood up best in the 1 per cent and 10 per cent solutions, but was badly attacked in the 30 per cent solution. Sample *A* stood up best in the 30 per cent solution. Sample *C* was badly attacked in the 1 per cent solution, and readily dissolved in the 10 per cent and 30 per cent solutions. Sample *D* stood up fairly well in the 10 per cent and 30 per cent solutions, but not so well in the 1 per cent solution. Sample *E* was readily attacked in the 1 per cent solution and badly attacked in both the 10 per cent and the 30 per cent solutions.

It also may be noted from the data in Table III that sample *C*, although highly resistant to the action of the mine water, was badly attacked in the acid solutions, and the sample *A*, although readily attacked in the mine water, was quite resistant to the acid.

To further elaborate on the relative resistive properties of alloys used in mine pumps, a 1-inch single suction centrifugal trial pump was built of castings made of the lead base alloy *M*-3 and the shaft, bolts and nuts made of the high-chromium steel. Three impellers were cast for this pump, one each of copper-base, nickel-base, lead-base alloy. These impellers were weighed and used in the trial pump, covering three periods of 30 days each, handling a bad mine water.

	Alloy	Per cent loss
First period	Copper base	1.418
	Nickel base	1.274
	Lead base	0.354
Second period	Copper base	2.256
	Nickel base	2.107
	Lead base	0.830
Third period	Copper base	13.521
	Nickel base	9.061
	Lead base	0.478
Total	Copper base	17.195
	Nickel base	12.352
	Lead base	1.662

The resistive values of metals, taking into consideration those which have been discussed herein, and other similar tests which the author has conducted, can be summed up as follows: When made up in the form of mine pumps, those metals which are highly resistant to the action of mine water are:

Lead or lead-base alloys.

Steel containing high percentages of chromium.

High silicon irons.

When made up in the form of mine pumps, those metals which are not highly

Table III

Tests of Discs Immersed in Sulphuric Acid

Metal	H_2SO_4	Time	Per cent loss	Remarks
Stainless steel *A*	1 per cent	10 days	0.489	No apparent action
Stainless steel *B*	1 per cent	10 days	0.017	No apparent action
Stainless steel *C*	1 per cent	10 days	33.342	Slight action at once
Stainless steel *D*	1 per cent	10 days	1.344	No apparent action
Stainless steel *E*	1 per cent	10 days	2.477	Slight action at once
Tobin bronze	1 per cent	10 days	0.417	No apparent action
High speed tool steel	1 per cent	10 days	6.034	Slight action in 2 hours
Stainless steel *A*	10 per cent	10 days	0.480	No apparent action
Stainless steel *B*	10 per cent	10 days	0.006	No apparent action
Stainless steel *C*	10 per cent	48 hours	100.000	Dissolved completely
Stainless steel *D*	10 per cent	10 days	0.781	No apparent action
Stainless steel *E*	10 per cent	10 days	27.311	Vigorous action at once
Tobin bronze	10 per cent	10 days	0.271	No apparent action
High speed tool steel	10 per cent	10 days	10.173	Action at once
Stainless steel *A*	30 per cent	10 days	0.229	No apparent action
Stainless steel *B*	30 per cent	1 hour	1.933	Taken out after 1 hour
Stainless steel *C*	30 per cent	5 min.	100.000	Dissolved in 5 minutes
Stainless steel *D*	30 per cent	10 days	0.442	No apparent action
Stainless steel *E*	30 per cent	10 days	25.392	Very vigorous action
Tobin bronze	30 per cent	10 days	0.035	No apparent action
High speed tool steel	30 per cent	10 days	20.829	Vigorous action at once

resistant to the action of mine water are:

Cast gray iron.
Copper or copper-base alloys.
Nickel or nickel-base alloys.

Zinc should never be used in any alloy for such purposes, especially in the cast form, owing to the fact that any minute particles of free zinc, which readily segregate, are instantly attacked by mine water. For this reason, the copper-base and nickel-base alloys which do not contain any zinc in their composition, are more satisfactory than the alloys which do include zinc. The detrimental effect of free zinc is not so apparent in the laboratory test, where the metal is immersed in still solutions, and subjected only to corrosion, but it shows in the practical test where the metal is subjected to the actual working conditions of a mine pump and to the two destructive agencies, corrosion and erosion.

How and Why in Brass Founding

By Charles Vickers

Making a Double-Sided Pattern Plate

We have been trying to cast a double-sided pattern plate of an alloy of 47 per cent zinc, 50 per cent tin, and 3 per cent bismuth. We have been unsuccessful because of segregation and shrinkage under the runners and risers, which are on top of the plate as it is cast within an iron frame. The plate is ¾-inch thick, and we wonder if this is too thick. It will be subjected to strenuous service as we first squeeze drags then turn the plate and squeeze copes.

The alloy stated never runs well without the addition of aluminum, but the addition of this metal should be exceedingly small. To a 100-pound pot of the white metal add a piece of ordinary sheet aluminum about 2 inches square, let it dissolve, then stir thoroughly. A change in the fluidity of the alloy immediately will be noted. We do not understand thoroughly how the casting is gated, as reference is made to runners and risers. This alloy need not be dropped onto the face of the mold. The iron frame we presume is molded with its upper side flush with the drag joint, using a box 4 inches larger than the iron frame. We would put the riser on the sand joint just outside the frame. A short distance from the riser would be a pouring sprue of small diameter connected to the root of the riser by a channel cut in the drag of the mold. Make the riser 3 inches in diameter, and run the casting by means of a channel cut in the cope and stepping across the frame and reaching over the inner side of frame not more than ¼ inch. Thus the runner will be a lump about ¼ inch by 2 inches on the edge of the plate where it contacts with the iron frame, and this is easily detached. The runner must not be flat. It must be an inclined plane sloping from the riser over the pattern frame. Use two or more such risers, sprues and runners. They will operate to flow the metal like a miniature falls down the inner side of the frame and from this point it will spread quietly over the face of the mold cavity, filling it and feeding the metal afterwards. Put a head on it, at least 6 inches high and have the mold well secured, and the frame hot. Treat the sand where the runner crosses the frame with silicate of soda and water to prevent washing.

Add Phosphorus to Lead Bearing Alloys

We manufacture, along with other nonferrous alloys, two leaded bronzes. The one contains, copper, 88 per cent; tin, 10 per cent; lead, 2 per cent. The other has, copper, 75 per cent, tin 10 per cent; lead, 15 per cent. These are troublesome alloys to cast and require great care in the foundry. The subject of the addition of a small amount of phosphor copper has come up and we ask if you have had any experience with the effects of the addition of phosphorus to leaded bronzes of this type. It is our impression that they assist in the liquation of the tin, something that is undesirable.

It is usual to add phosphorus to the alloy containing 15 per cent of lead, to assist in getting sound castings. Phosphorus also can be added to the alloy with the 2 per cent of lead, but for this especial alloy the addition of 2 per cent of zinc produces better results. This latter alloy should, if possible, be changed to copper, 86 per cent; tin, 10 per cent; lead, 2 per cent; zinc 2 per cent, with the addition of 2 ounces of 15-per cent phosphor copper, and no further trouble will be experienced. This information was obtained as a result of research work with this particular alloy, extending over a considerable period. The zinc will do no harm even though the alloy is used for supposedly acid resisting purposes, but minus the zinc, even with the use of phosphorus, the alloy always will give a certain amount of trouble in the foundry.

A quarter per cent of a 15-per cent phosphor copper should be added to the 15-per cent lead alloy. It is not likely there will be any liquation of tin. When lead is present the phosphorus does not promote liquation of the tin so readily as when lead is absent. Thus an alloy containing over 10 per cent tin, and considerable phosphorus is much given to liquidation, and some times zinc is added in small amount in the effort to correct this. Alloys of copper 80 per cent; tin 10 per cent; lead 10 per cent, with as high as 1 per cent of phosphorus are made and used. This high phosphorus segregates as phosphide to the outer skin of the castings, and the lead gravitates inwards making the castings difficult to machine, as they will contain hard spots.

Aluminum Put in Brass Produces Dross

We are making yellow brass cover castings using an alloy of copper, 63 per cent; lead, 4 per cent; tin, 1 per cent and zinc, 32 per cent, fluxing with aluminum. These castings, as you can observe from the sample we are sending you, come drossy. This is objectionable as they must be polished and plated. Is there any way we can overcome this difficulty?

The dross is produced by the aluminum used for fluxing purposes. The aluminum confers fluidity on the brass and renders it easy to run the castings. As the more aluminum there is added the larger amount of dross is formed, it is important to keep it as low as possible. If 2 ounces are added to 100 pounds of brass, it is much in excess of the requirements and experiments should be made to cut it to the lowest possible point, then cleaner castings will be obtained. The castings can be run minus aluminum, but this will require the services

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

THE FOUNDRY DATA SHEET, DEC. 1, 1923
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

CONTRACTION OF LIGHT ALUMINUM ALLOYS

(*Continued from Data Sheet No.* 502)

Contraction in Sand Molds

Effect of Copper—The following table shows the effect of increasing copper on the contraction of aluminum in amounts of up to 14 per cent, in the case of three different bars poured at 700 degrees Cent. and of two bars poured at 900 degrees Cent. In the case of the 0.5-inch square bars poured at 700 degrees Cent., the contraction falls from 1.65 per cent to 1.30 per cent on increasing the copper up to 14 per cent, and there is a corresponding drop in the case of the other bars. In the case of the bars poured at 900 degrees Cent., the contraction falls with increasing copper up to 12 per cent, and then rises with further increase to 14 per cent.

Linear contraction of binary aluminum-copper alloys; bars of different cross sections poured at high and low temperatures in sand molds.

Alloy Number	Nominal Composition	Linear contraction, per cent, for bars poured at 700 degrees Cent. 0.5-inch square bars	1.0-inch square bars	0.5 by 1.0 inch bars	Linear contraction, per cent, for bars poured at 900 degrees Cent. 0.5-inch square bars	1.0-inch square bars
1	100 Al	1.68	1.68	1.64	1.54	1.60
2	96:4 Al-Cu	1.43	1.57	1.47	1.43	1.48
3	92:8 Al-Cu	1.42	1.43	1.37	1.33	1.40
4	90:10 Al-Cu	1.40	1.40	1.39	1.28	1.37
5	88:12 Al-Cu	1.35	1.40	1.37	1.25	1.27
6	86:14 Al-Cu	1.30	1.33	1.33	1.28	1.32

Effect of Iron—It is shown by the measurements that increasing iron has practically no effect on the contraction of aluminum-copper alloys when cast in sand molds at 700 degrees Cent., as contrasted with casting in chill molds where increasing iron decreases the contraction. This is one of the marked anomalies between the values for alloys cast in different types of molds. Some comparative figures are given in the following table.

(*Continued on Data Sheet No.* 504)

CONTRACTION OF LIGHT ALUMINUM ALLOYS

(*Continued from Data Sheet No.* 503)

Linear contraction of aluminum-copper-iron alloys; bars of different cross sections poured at high and low temperatures in sand molds

Alloy Number	Nominal Composition	Linear Contraction, per cent, for bars poured at 700 degrees Cent. 0.5-inch square bars	1.0-inch square bars	0.5 by 1.0 inch bars	Linear Contraction, per cent, for bars poured at 900 degrees Cent. 0.5-inch square bars	1.0-inch square bars
3	92:8 Al Cu	1.42	1.43	1.37	1.33	1.40
17	90:8:2 Al-Cu-Fe	1.43	1.42	1.48	1.45	1.43
18	88:8:4 Al-Cu-Fe	1.40*	1.42*	1.41*	1.32**	1.40**

* Poured at 850 degrees Cent.
**Poured at 950 degrees Cent.

Effect of Magnesium—Magnesium has a pronounced effect in lowering the contraction of aluminum and aluminum-copper alloys as may be noted from the figures in the following table. Thus, the addition of 8 per cent magnesium to aluminum lowers the contraction from 1.68 to 1.23 per cent in the case of 0.5-inch square bars poured at 700 degrees Cent. The addition of 0.5 per cent magnesium to the 92:8 aluminum-copper alloy lowers the contraction from 1.42 to 1.30 per cent, under the same experimental conditions.

Linear contraction of some magnesium-containing aluminum alloys; bars of different cross sections poured at high and low temperatures in sand molds.

Alloy Number	Nominal Composition	Linear Contraction, per cent, for bars poured at 700 degrees Cent. 0.5-inch square bars	1.0-inch square bars	0.5 by 1.0 inch bars	Linear Contraction, per cent, for bars poured at 900 degrees Cent. 0.5-inch square bars	1.0-inch square bars
1	100 Al	1.68	1.68	1.64	1.54	1.60
7	96:4 Al-Mg	1.47	1.49	1.49	1.50	1.50
8	92:8 Al-Mg	1.23	1.23	1.22	1.24	1.27
3	92:8 Al-Cu	1.42	1.43	1.37	1.33	1.40
19	91.5:8:0.5 Al-Cu-Mg	1.30	1.38	1.30	1.23	1.39
20	90:8:2 Al-Cu-Mg	1.22	1.24	1.23	1.16	1.23

(*Continued on Data Sheet No.* 505)

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of an experienced yellow brass pourer. Besides an alloy with 32 per cent zinc, and 4 per cent lead, is likely to run specky, just as though some sharp core sand had been mixed in and was distributed over the surfaces of the castings.

If these suggestions fail to improve matters, determine the cost of the castings as made at present, with losses added, then run a few heats of the following alloy: Copper, 70 per cent; zinc, 26 per cent; lead, 2.5 per cent; tin, 1.5 per cent; aluminum none. Pour hot and keep the sprue filled all the time the mold is taking metal. Then if it is decided to use the more expensive alloy, the price could be lowered a little by the use of ingot metals bought to specifications.

Color of Bronze Bushings Is Variegated

We are sending for your inspection a sample of metal broken out of a bushing about 4¾ inches in diameter, 4 inches long, and having a metal thickness of 1 inch. This sample is the full length of the bushing and shows the fractured surfaces which you will note show an unhomogeneous alloy, filled with copper-colored and lemon-colored areas, some of them of large extent. We have several opinions as to just what causes this trouble, but would like to know yours also. The alloy is copper 77 per cent, tin 6 per cent, lead 14 per cent, balance undetermined. The castings are made from all scrap melted in a oil-fired noncrucible furnace of the teapot type, in 2000-pound heats.

Most of the *undetermined* balance is zinc, but also there is too much phosphorus for the good of the alloy. We have a suspicion the analysis of the alloy would differ materially from that given which appears to us to be simply guesswork. Some of the differently-colored parts of the alloy are oxides. The large copper spots are caused by the absence of the eutectic which is of a blue color and when present gives to the fractured surface the normal grayish color of the metal chilled by the sand. These copper-colored spots under the microscope are porous, and analysis shows a different composition. The cause of this change is too much phosphorus for the type of alloy, and it will be found that cutting down on this element will materially assist in getting homogeneous castings. The foregoing remarks are not an opinion, they are made as a result of a considerable chemical and microscopic investigation of such phenomena.

Should your various opinions fail to coincide with the views advanced by the writer we suggest a similar sample be given to a competent chemist for analysis. and to a metallographist for microphotographs of the differently-colored areas.

Why Babbitted Linings Become Pitted

Can you advise us the cause of pits which appear in a babbitted lining after broaching. They are apparently bubbles, cut by the broaching tool. We propound the following questions.

1—What is the cause of these pits?

2—Has the amount of antimony in the metal anything to do with their formation?

3—Has the amount of tin anything to do with their formation?

4—Has the ratio of antimony to tin anything to do with their formation?

5—Can a metal with 11 per cent antimony, 3 per cent tin, 85 per cent lead, be broached without showing these pits?

6—Can such a lining metal be burned?

7—Does burning make it unfit for use?

8—Does burning make it brittle?

9—How can brittleness be removed?

10—What temperature will injure lining metal of the composition given?

11—What is the proper temperature at which to pour linings of the above composition, for bearings 5/16 inch thick?

12—Will burned lining metal, added to new pigs of metal, spoil the whole?

1—A number of causes can account for the pits. They may be caused by oil on the mandrel; too cold a mandrel; pouring with a broad, thin stream of metal (the ladle spout should be rounded); heating the babbitt too rapidly; insufficiently stirred and mixed metal; or dross flowing into the bearing.

Heat the mandrel to around 300 degrees Fahr., maximum. In melting, heat slowly, and when about to pour flux with rosin. Stir the molten metal after fluxing, and pour whenever possible with the mandrel in a vertical position.

Questions 2 to 4 are answered by a *no*, while *yes* answers question 5.

6—It can be oxidized by heating red hot for some time. When *burned* the alloy will run thickly. It is restored by bubbling gases through it. The gas is produced from sticks of green wood held at the bottom of the kettle.

7—No—*burning*, as already noted, makes it *thick*, and it fails to run and fill the mandrel.

8—No—the percentage of antimony makes it brittle.

9—By adding more lead and tin.

10—The pouring temperature for babbitt of the composition given is 615 degrees Fahr. It is completely liquid at 500 degrees Fahr. For heavy bearings a lower temperature can be used than for thin bearings.

11—Six hundred and fifteen degrees Fahr.

12—If added in too large amounts burned lining metal will render new metal viscid so it will not flow properly. Then it needs refining by boiling with sticks of wood, continuing the boiling until complete fluidity is restored. Zinc also is a fruitful source of trouble in this metal. It causes the metal to dross badly, will produce blisters, and robs it of fluidity. Zincy metal should be sold to the refiners.

Removing Zinc in Alloys

A considerable amount of scrap and borings that contain from 1 to 4 per cent zinc accumulate, as a result of our manufacturing process. We wish to use this material but certain of our alloys contain no zinc, consequently we are looking for a method of removing zinc when necessary. We have tried burning it out but have not been successful.

Zinc in the alloy can be used as a reducing agent to liberate the metal from some other oxide and in so working it is eliminated as oxide from the metal. About the only oxides that are commercially feasible for such a purpose, are lead oxide and copper oxide. Litharge (lead oxide) contains around 7 per cent oxygen, and zinc oxide close to 20 per cent oxygen. It is evident that 3 pounds of litharge will be required to remove 1 pound of zinc, thereby adding a little more than 2.75 pounds of lead to the bath. With litharge at 9c per pound the 2.75 pounds of lead would cost 27c, besides the loss of 1 pound of zinc. The way to use it is to stir the litharge into the molten metal. Lead oxide is easily reduced by carbon and therefore it would be foolish to use charcoal on the metal. In practice it will be found that considerably more than the theoretical amount of lead oxide will be required. When lead cannot be added to the alloy, copper oxide must be used. It might be used exclusively only it appears difficult to obtain in quantity, and may command a premium. The only way to discover how much of these oxides will be required to remove a given quantity of zinc is by actual experiment. Then theoretically about 25 pounds of copper oxide should remove the aluminum from 100 pounds of 10 per cent aluminum bronze but actually there is required no less than 80 pounds. Of course the copper is recovered; all that is lost is the weight of the oxygen in the oxide and the weight of the metal removed. However, why remove the zinc? This metal up to 5 per cent improves the bearing qualities of highly leaded alloys.

Plow Grinding Practice Novel

Chilled Iron and Steel Plow Parts First Are Surfaced with Grinding Wheels and These Are Polished by Abrasive Grain—Rigging Described—An Attractive Finish Is Sought

BY FRED B. JACOBS

PLOW manufacture is one of the most important branches of the implement trade. Unlike many other industries it is not confined to any one manufacturing section as plow works are found in various localities where a large agricultural trade can be served to advantage. In the manufacture of plows abrasives are relied upon to expedite production and to impart an attractive appearance. At one time grindstones were the only abrasives used, but they have been practically replaced by the faster cutting artificial abrasives.

At the plant of one typical plow manufacturer located in the Middle West, grindstones were replaced by grinding wheels more than 20 years ago and with the introduction of improved wheels production costs were reduced materially.

Two general types of plows are manufactured, chilled iron and steel. Each type has its advantages.

Chilled plows are popular in many sections of the country, but without modern abrasives it would be impossible to manufacture them on an economical basis owing to the hardness of the material as chilled iron cannot be worked with ordinary cutting tools. The four principal parts on an ordinary plow are the point, the moldboard, the landside and saddle, or frog. The point breaks the soil, the moldboard turns the furrow and the landside, as its name indicates follows the land side of the furrow. The saddle holds the parts together. The four foregoing members constitute the plow base. Plows can be made right or left hand, but a large majority are right hand. A right-hand plow, for example, throws the furrow to the right of the plowman, and a left-hand plow to the left.

An ordinary hand plow is guided by hand and is pulled by one or more horses. A smaller type of this plow, called a pony or garden plow, also is popular in some sections of the country and abroad. A riding plow is mounted on wheels and is equipped with a seat for the driver. A coulter plow has a coulter or soil breaker mounted just ahead of the point. The coulter can be a disk or a straight member. It serves to open the furrow and thus is useful in difficult soil. A gang plow consists of several plow bases mounted on a frame to be drawn by a tractor. The so-called *middle buster* is a double plow that turns two furrows, one to the right and the other to the left. Special plows also are used for a diversity of purposes such as breaking up roads for resurfacing and on other forms of construction work. The majority of plows, however, are used for tilling the soil.

At this plant in the Middle West, grinding operations have been standardized, the two general departments for finishing chilled and steel plows being conducted separately. Hand grinding operations are performed on substantial stands equipped with protection hoods. Surfacing operations are conducted under wheels located between safety collars, the

FIG. 1—CHILLED IRON PLOW POINTS ARE HELD ON A CRADLE AND PASSED UNDER THE WHEEL BY HAND

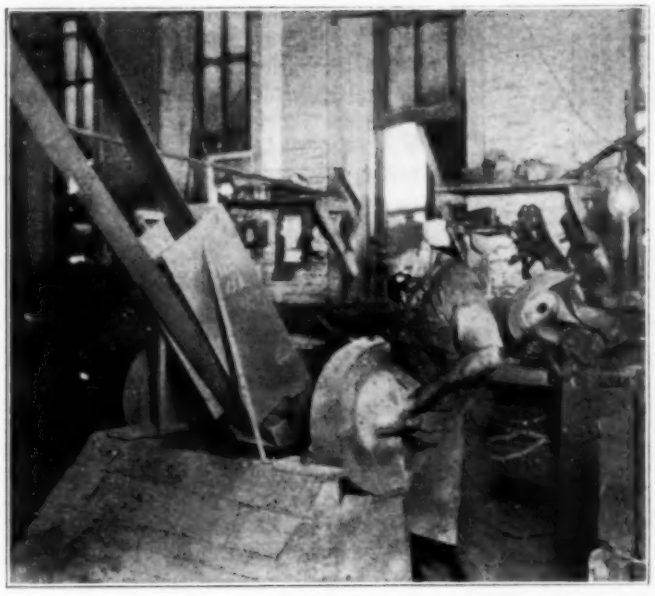


FIG. 2—THE EDGES OF THE SECTIONS ARE GROUND TO MAKE THE PARTS FIT ACCURATELY

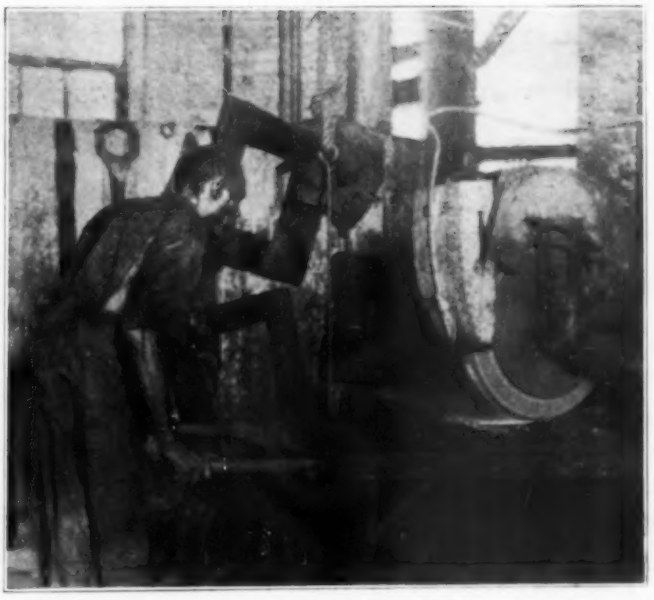


FIG. 3—SURFACING A CHILLED IRON PLOW BASE—A STREAM OF WATER KEEPS THE WORK COOL

work being supported on cradles as in ordinary plow-grinding practice. On all dry grinding operations, the dust is carried away by an exhaust system. Carbide of silicon wheels are used for grinding chilled iron, while the steel plows are surfaced with artificial alumina wheels. Polishing also is performed with artificial alumina grain.

The operation illustrated in Fig. 1 consists of grinding chilled plow points. If the parts are for replacement they are ground all over and the edges are fitted to an accurate template. This is necessary, of course, as the parts often must fit a plow that was made several years previously .On regular production work, however, the point is not surfaced. As the illustration shows, the work is mounted on a hand-operated cradle so that the workman can pass it under the wheel. As the cradle can be tilted sidewise, the edges can be ground easily. The wheel used is silicon carbide 18 inches in diameter, 3-inch face and 16-grit, hard grade.

Plow fitting consists of assembling a point, landside saddle or frog and moldboard to form the base. Each part is ground with relation to the bolt holes to fit a template. This operation is illustrated in Fig. 2. The wheel is silicon carbide 18 inches in diameter, 2-inch face and 16-grit, hard grade.

Extra moldboards also are ground to fit the templates in this department. The secret of economical plow fitting is to insure accurate castings, which reduces the amount of metal to be removed to make the parts conform to the template. If the patterns are rapped too much in the foundry the castings will be slightly oversized which entails extra fittings. Thus accuracy of the molder's part is essential to maintain production costs at a minimum. Accurate patterns, of course, are necessary, but if it is shown that an excess of metal invariably is in evidence, the pattern is altered slightly.

The assembled plow base is surfaced as shown in Fig. 3, under a silicon carbide wheel 30 inches in diameter, 3-inch face and 16-grit, hard grade. This operation is performed wet as wet grinding has proven to be economical under these conditions. As the illustration shows, the base is set in a cradle and is passed back and forth under the wheel by hand.

The cradle is always counterweighted

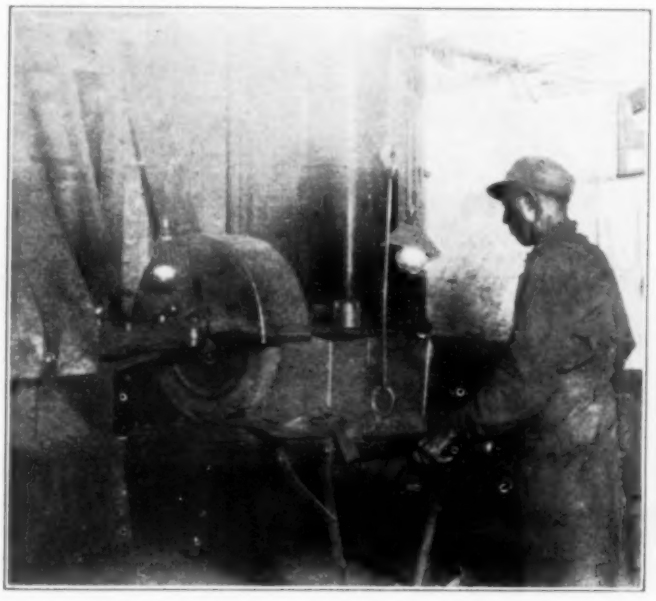


FIG. 4—STEEL PLOW PARTS ARE POLISHED UNDER WHEELS SET-UP WITH ARTIFICIAL ALUMINA

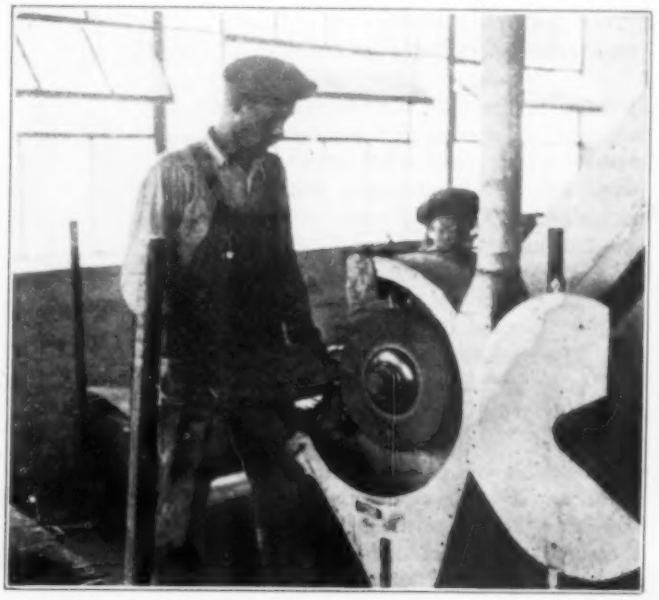


FIG. 5—STEEL PLOW PARTS ARE EDGED BY HAND—AN EXHAUST HOOD CARRIES AWAY THE DUST

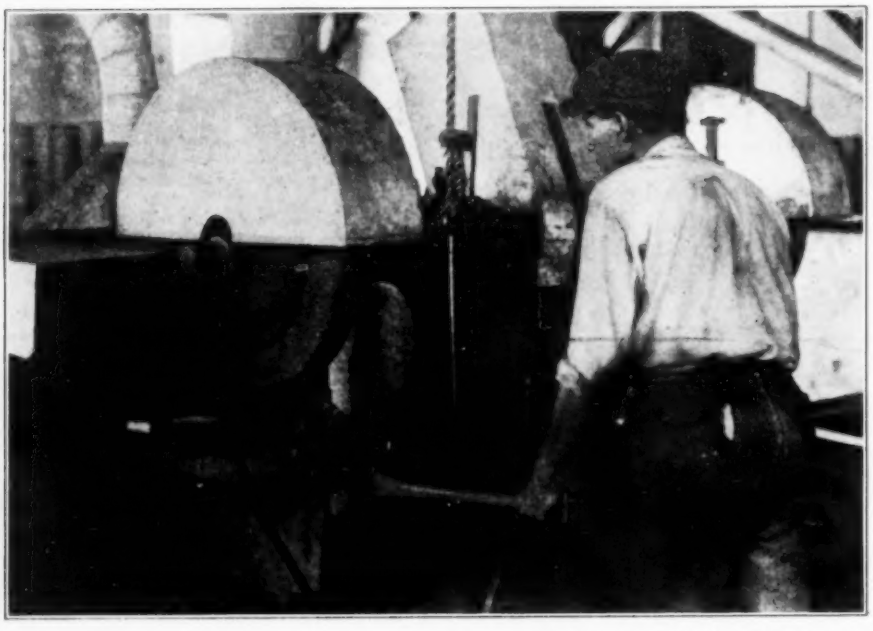


FIG. 6—CUTTING-OFF STEEL PLOWS—THIS OPERATION GRINDS AWAY THE BOLT HEADS AND OTHER IRREGULARITIES

so that the operator does not have to exert himself unduly in holding the work against the wheel. Surfacing is an important operation as it prepares the plow for the final polishing operation. It also grinds down the heads of the bolts that are used to hold the sections together. Moldboards for replacement also are surfaced in this department. As the moldboard is exposed to excessive wear, this part must be stocked by implement dealers. As a matter of fact, the making of replacement parts forms an important part of the plow-manufacturing business. While a plow, as a unit may last from 10 to 15 years, depending on the care it has had, it will wear out a number of points and moldboards during its life.

Polishing Plow Bases

The final abrasive operation in the manufacture of chilled plows consists of polishing the base. A typical polishing operation is shown in Fig. 4. The work is located on a cradle of the same type as that used in plow grinding, while the wheel is a steel-center canvas unit set-up with alundum grain. Various grit numbers are used successfully, namely Nos. 36, 46, 60, 80, 120, 150 and 180. These wheels are operated at an approximate peripheral speed of 8000 feet per minute. The grinding wheels, however, used in the previous operations are run at 5500 feet per minute peripheral speed.

Polishing is one of the most important operations in plow manufacture as the plow must *scour* satisfactorily and this is assured by correct design and proper polishing. Brightly finished plows also command the attention of the prospective purchaser, although not affecting its work.

This company recently moved the steel plow branch of its business into new quarters as shown in Figs. 5, 6 and 7. The building is a four-story fireproof reinforced-concrete structure. The machines are so arranged that the work progresses from one department to the next with a minimum of backtracking. In the majority of instances the wheels are mounted between safety flanges, while an up-to-date exhaust system carries away the abrasive dust. Large, steel sash windows afford ample material light.

The various parts for steel plows are purchased from steel manufacturers in the form of so-called *plow shapes*, which are forged and machined to the dimensions and contours desired. Thus, one shape of moldboard can be used as a basis for fabricating a number of models. After the various parts have been forged to the desired shape the point and moldboard are fitted together by planing on a metalworking shaper. A certain amount of edge grinding is necessary in shaping the points and in setting-up the bases. This is done on a wheel of artificial alumina 18 inches in diameter, 2-inch face, 16 grit, medium grade, as shown in Fig. 5. The dust guard was opened to show the wheel.

Grind Off Bolt Heads

The next operation, technically called *cutting off*, is shown in Fig. 6. Here the assembled plow base is located on a cradle and is passed under the wheel by hand. This wheel is artificial alumina, 30 inches diameter, 3-inch face, 16-grit, medium grade. The object of this operation is to make a uniform joint where the point and moldboard meet and to grind away the projecting bolt heads. Next, the bases are polished. This operation is performed under a steel-center canvas wheel set-up with No. 36 grit alumina. With the exception that a polishing wheel is substituted for a solid one, the operation resembles that shown in Fig. 6. Repair parts for steel plows also are made in large quantities. The operations do not differ materially from those followed in making chilled replacement parts, including fitting to templates and surfacing. In addition, it is necessary to temper and repolish the steel parts.

The two interesting operations shown in Fig. 7 indicate that precision grinding machinery can be used to advantage in plow manufacture. This machine is a disk grinder carrying an artificial alumina wheel on one side and a thick

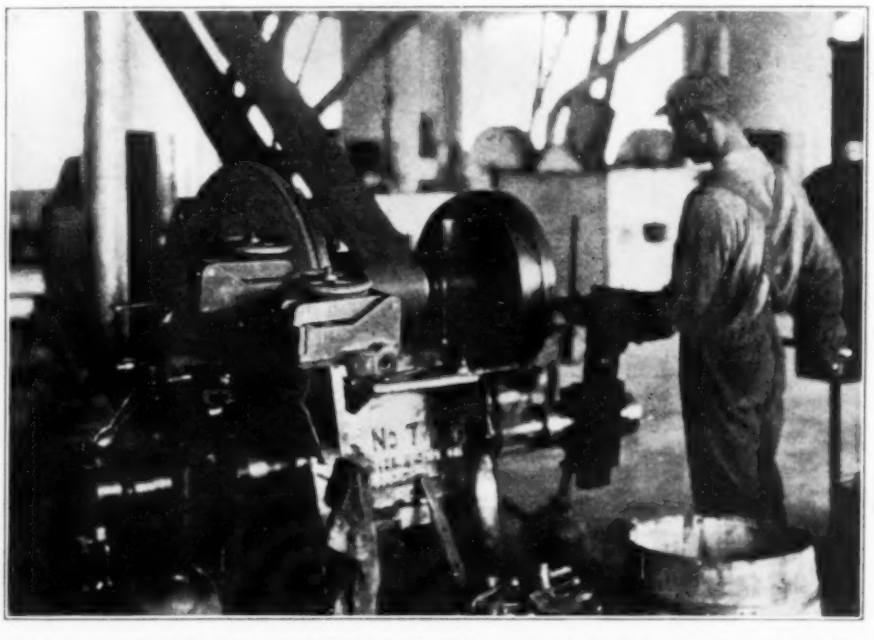


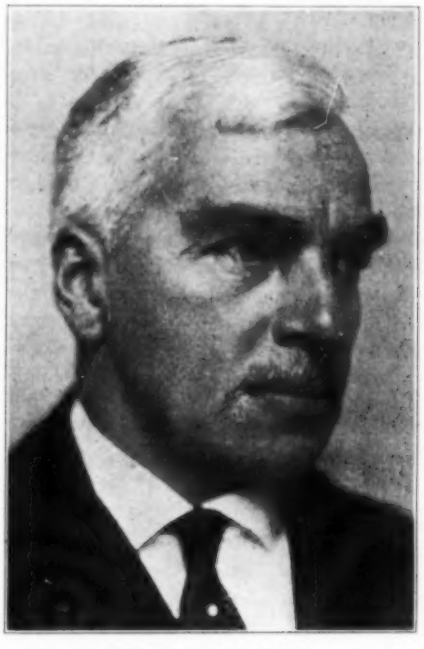
FIG. 7—A MODERN DISK GRINDING MACHINE IS USED TO SURFACE VARIOUS PLOW COMPONENTS

abrasive disk on the other side. At the right the operator is grinding the sides of connecting links while the fixture shown in position at the left is for surfacing the edges of tie beams. For this work grinding has proved to be more economical than surfacing by planing. That finish is important in plow manufacture cannot be disputed, because attractive goods always command attention. For this reason, plow manufacturers adopt standard finishes and colors and adhere to them. This is of special importance in holding foreign trade, as these purchasers are influenced largely by the appearance of the plow and even a slight change in the color of the transparent paint used to protect the metal surfaces may result in the loss of this trade. As a general rule agricultural implements are painted attractively.

Cites German Foundry Developments

MODERN German iron foundry practice was discussed by Dr. S. G. Werner, Dusseldorf, president of German Foundries' association, at a meeting of the Chicago Foundrymen's club, Saturday evening, Nov. 10, at the City club, Chicago.

Dr. Werner gave a full account of the operation of a cupola which works with side blast, that is, preheated. This type of cupola was described in THE FOUNDRY of June 15, 1923. F. K. Vial of the Griffin Wheel Co., Chicago, while visiting in Germany last year, called on him, Dr. Werner said, and it was decided to install a trial cupola at the Sacramento Square plant of the Griffin Wheel Co. He said that this cupola has been operated and has given satisfaction, although the conditions at the Sacramento Square plant are much different from those which prevail in the average foundry in Germany. The most important feature of the new system, the speaker claimed, was the saving of fuel, which is guaranteed for average foundry practice, to be at least 25 per cent. Besides this saving of fuel, he claimed, the sulphur content of the molten iron is diminished by at least 25 per cent. The melting zone in the new furnace is kept much lower than is usual with the normal cupola, therefore, it is possible, the speaker said, to start at a comparatively low distance above the tuyeres with iron brick. The flame on top of the charge disappears entirely, he said, and the temperature on top of the furnace is low, facilitating the operation of center charging cranes of the type manufactured in the United States, for instance, by the P. H. & F. M. Roots Co. Dr. Werner said that all the different foundries in Europe that are using cupolas which have been changed to the new system, claim that the side blast furnace allows a much greater variation in the melting rate during melting hours; one large foundry, for instance, starts with 6 tons per hour capacity in the first hour, and runs the furnace in the next hour at the rate of 15 tons per hour, then slackens down toward the end of the melting time to 5 tons per hour. The composition of the



DR. S. G. WERNER

molten iron, Dr. Werner said, remains constant even with this variation in melting rate. He claimed that the temperature of molten iron is 50 to 70 degrees Cent. higher than the molten iron from a normal cupola of the same size that is running with 25 per cent more fuel. Also that the life of the lining of the furnace has been found to be more than four times longer than in the normal cupola. The furnace is covered by United States patents.

Dr. Werner spoke about a new grade of cast iron that has been developed but recently in Germany, called *pearlitic* cast iron. He said that this iron has a finer grain structure, and a greater bending deformation than the normal cast iron; also that it will stand up better for wearing purposes. In this connection the speaker showed a number of diagrams and metallographic photographs, illustrating the structure of pearlitic cast iron, and the importance of high temperature of the molten iron when pouring.

As another feature of modern European cast iron foundry practice, Dr. Werner referred to the different inventions of Richard Walter, now living at Nuremberg, Germany. Mr. Walter has developed an entirely new way of producing acid-resistant castings. The patent rights of this method are in the hands of the Firm of Krupp, at Essen, and it is supposed that one or several large foundries in the United States will soon be working under the new method. In describing the process Dr. Werner said that in making his acid-resistant castings, Mr. Walter makes use of the reaction which takes place between silicon and iron when both of these materials are heated together to a temperature of about 1150 degrees Cent. The reaction which takes place at this temperature is accomplished by the development of a high temperature—more than 3000 degrees Cent.—as the reaction is exothermic. The speaker said that the fluid mixture of silicon and iron, containing 40 per cent of silicon, is homogeneous consisting of iron silicides. The grain is fine and no graphite particles show in the fracture. With all the other methods which have been used heretofore for making acid-resistant iron castings, Dr. Werner said, the ferrosilicon is added to the molten iron, but in that case it is impossible for the silicon to go into solution, because the melting temperature of silicon is higher than the melting temperature of the iron. By Mr. Walter's method, the speaker claimed, the most complicated castings can be made without undue difficulty. He said Mr. Walter has given much of his attention also to the addition of boron to cast iron and cast steel. His work in this line has been covered by a great number of patents and though it has not been possible to put all of his ideas to practical work, the results which have been obtained by the addition of boron to molten cast iron and cast steel, seem to be of the greatest importance. Continuing, Dr. Werner said, it appears that Mr. Walter shows entirely new ways of influencing the formation of the structure in iron and steel. At the same time, boron will enable foundrymen to make cast iron that can be hardened in a simple manner.

Dr. Werner went into several details describing the methods of Mr. Walter's inventions. In cast steel

foundry practice. He said, boron may help to get the fine-grained structure without annealing. Recently Mr. Walter has given much of his work to the production of synthetic pig iron out of the cupola and has had remarkable success at one of the larger foundries in Germany, the speaker said, and forecast that this new way of producing pig iron also will become of interest for the foundries in the United States.

Concluding, Dr. Werner gave a description of the new Fiat electric melting furnace that has been designed by Gavalliere Massera, of the Fiat works in Torino, Italy, and described in THE FOUNDRY of March 1, 1922. Dr. Werner said that the first furnace of this type in Germany will be installed at one of his works.

Ohio Foundrymen Meet in Toledo

MORE than 150 foundrymen from Ohio, Michigan and Indiana attended the two-day meeting of the Ohio State Foundrymen's association held in Toledo, Nov. 15 and 16. Following a luncheon tendered at the Toledo yacht club by the foundry and metal trades associations of Toledo, Thursday noon, Nov. 15, a business and technical session was held in the assembly room of the club. Mayor B. F. Brough extended official courtesies which were acknowledged by L. B. Weber, Elmwood Castings Co., Cincinnati, former president of the Ohio association.

In a paper on insurance, W. M. Todd, district manager, Western Adjustment Co., Toledo, advised the foundrymen concerning points in their insurance contracts, urged them in event of loss to care for damaged machinery and equipment, to salvage as much as possible, and recommended adequate insurance as protection. Fred L. Wolf, technical superintendent the Ohio Brass Co., Mansfield, O., in a short paper offered suggestions on practical brass foundry operation through scientific control. Foundry costs occupied the attention of the foundrymen in a discussion led by E. T. Runge, E. T. Runge Cost Co., Cleveland. Adequate and properly computed overhead charges were pointed out by the speaker as essential under present day competitive conditions. D. M. Avey, managing editor, THE FOUNDRY, discussed the pattern problems of the jobbing foundry, considering features of design, construction, care, storage, insurance and other responsibility on the part of the foundryman.

The round table discussion led by A. J. Tuscany, secretary of the association, covered the possibilities of credit investigation and mutual fire insurance. Abstract cost considerations were presented. T. E. Jones, state board of vocational education, in a short address outlined the assistance which Ohio offers in training foremen.

At the banquet held Thursday evening greetings to the Ohio association were extended by J. Edgar Lee, Grand Haven, Mich., president of the Michigan Foundrymen's association, and A. J. Rumely, LaPorte Foundry & Furnace Co., Laporte, Ind., secretary of the Indiana State Foundrymen's association and A. E. Hageboeck, Moline, Ill., president Quad City Foundrymen's association. Entertainment features at the smoker which followed were provided by associated pig iron and supply representatives of the district. Friday, Nov. 16, was devoted to an inspection of the Willys-Overland Co. automobile plant and the Toledo Furnace Co.

Five new members were elected to the board of administration of the association. These were J. H. Bruce, Bowler Foundry Co., Cleveland; George Alten, Alten's Foundry & Machine Co., Lancaster, O.; H. Loudenslager, H. Loudenslager Foundry Co., Columbus; I. W. Warden, Wellston Mfg. Co., Wellston, O.; A. H. Kramer, Advance Foundry Co., Dayton, O.

All officers were re-elected for the coming year. These are F. W. Huber, president, American Rolling Mills Co., Middletown, O.; J. H. Bruce, vice president, Bowler Foundry Co., Cleveland; Walter Seelbach, treasurer, Walworth Run Foundry, Cleveland, and A. J. Tuscany, secretary-manager, Cleveland.

Book Review

Kent's Mechanical Engineers' Handbook; Robert T. Kent, editor-in-chief; flexible binding; 2247 pages, 4½ x 7 inches; published by John Wiley & Sons Inc., and furnished by THE FOUNDRY, Cleveland, for $7.00 in genuine leather and $6.00 in atholeather, postpaid.

Seven years have elapsed since the ninth edition of this handbook was published and although it was considered the most complete mechanical engineering authority in the English language, the tenth edition just published is even more complete. The new volume contains over 700 pages more than the earliest edition, nine new sections having been added. Practically every section has been revised to include the latest developments in progress. Robert Thurston Kent, the editor-in-chief, and son of the late William Kent, the original author of the handbook, has spent three years in revising the book with the assistance 31 leading authorities.

Engineers and students already are familiar with the type of information contained in the handbook. The new edition contains under materials of engineering, many new tables of sizes, weights and properties of the commonly used materials, the latest standards of engineering societies and manufacturers' associations. It takes up the fundamental theory of the mechanics of stresses of beams, columns, shafts, etc., in such a form as to be of the greatest service without the use of any more mathematics than is necessary.

New subjects included in the book for the first time are: Automotive vehicles, aeronautics, hoisting and conveying, industrial furnaces, forge shop fusion welding and cvutting, malleable castings, reinforced concrete and safety engineering. Considerable new information has been presented in the foundry practice section and includes in addition to many tables a certain amount of text matter. Those interested in steel foundry practice will be disappointed, however, not to find more information on steel castings, little data being given on this subject.

Among the contributors to the new edition of the handbook are a number of men recognized as authorities in metallurgical subjects. Zay Jeffries contributed the information on aluminum, tungsten, and molybdenum; Paul D. Merica, the material on nonferrous metallurgy and copper; Robert Peele, the text on compressed air; F. N. Speller, the data on corrosion; Bradley Stoughton, the outline on iron and steel; Endique Touceda, the chapter on malleable castings; and W. Trinks, the information on steam engines, governors and industrial furnaces.

Stow Mfg. Co., Inc., Binghamton, N. Y., manufacturer of flexible shaft portable tools, recently sent out a number of circular letters attached to each of which was a 50,000 mark German note. An analogy was drawn between the depreciated currency and the loss through depreciation in inferior tools.

Describes Cupola Reactions

Reference Is Made to and Conclusions Are Drawn from Contemporary Literature on Many Phases Incident to the Process of Melting Iron in a Cupola Furnace

BY LIEUT-COL. JAIME COLL

EXAMINATION, either superficial or extended, of the many papers written on the subject of cupola operation, tends to bewilder the average foundryman rather than give him a clear conception of the many reactions that take place while the stock is descending from the charging door to the tapping spout. From the discussion that followed the presentation of George K. Elliott's exchange paper at the Blackpool conference it is apparent that competent foundrymen hold conflicting opinions on the value of superheating. The same is true in regard to the various positions recommended for the steel in making up the semisteel charges. From a general review of the situation one is justified in assuming that no person knows positively what takes place inside the cupola.

At first sight it would seem that with all the data on file, data covering facts in which theory and practice have walked hand in hand, the only requisite would be to discover a few missing links to establish a common platform of knowledge and thus prevent the wide discrepancies that now exist in the opinions held by prominent foundrymen on the subject of melting iron.

The claim is not advanced that the question easily can be clarified. However, a repetition of Belden's (1) * experiences with a cupola charged as in ordinary practice—that is with both coke and iron—probably would throw considerable light in the dark and shady places.

Theories advanced by S. J. Felton (2)* and valuable practical experiments carried on by John Grennan (3)* at the University of Michigan have opened a path which may lead to some satisfactory explanations. The work will be expedited to a considerable extent if metallographists can determine exactly when, where and how the transformation or solution of the graphite in the matrix within which it is mechanically mixed, takes place in the cupola. When this goal is reached, the results of the work taken together with experiences of other men working under widely separated conditions and in widely separated parts of the world, may serve as a basis from which one may explain, at least tentatively, some current facts and from which one may point out the main lines of research to be followed.

Moisture in Coke

Accepting the accuracy of the temperatures measured by Grennan, corroborated to some extent by his visual observation of the material while in process of melting, the efficacy of moistening the coke as advocated by Matthew Riddle, appears to be of questionable value. According to the proponents of the moistening process, the temperature is reduced and therefore the increases of combined carbon in the descending metal is delayed. With a temperature of at least 800 degrees Cent. above the tuyeres it is difficult to imagine the presence of even a trace of moisture. However, there must be some advantageous feature in the practice, although up to the present it has not been explained, because E. V. Ronceray (4)* also claims that the practice is distinctly beneficial.

While considering the subject of semisteel charges it is necessary to remember that a temperature of 900 degrees Cent. may exist close to the charging door. Steel at this temperature begins to absorb carbon and the melting point is lowered to a corresponding degree. The steel scrap takes carbon from the gas or the incandescent coke and therefore the most logical position for the steel is either on top or on the bottom of the charge where it will come into immediate contact with the coke. While it is true that all the materials in each charge intermingle in the vicinity of the melting zone, thereby supporting the claim sometimes advanced that it does not matter whether the steel is charged on the top, bottom or center, still the fact that a temperature of 900 degrees Cent., may exist close to the charging door might lead one to infer that some of the intermingling takes place between that point and the melting zone.

Carburization does not take place to any extent in the first stage because according to the experience of J. Cameron * (5) an extended action is necessary at the critical point Ac 3, to show any appreciable carbon absorption. Bars withdrawn from the cupola a few moments before melting and analyzed, indicated that the absorbed carbon did not amount to 0.65 per cent. Several hours' contact were required to effect the cementations cited by J. E. Fletcher *(6).

A possibility exists that the carbon absorbed by the bars might not have been distributed evenly throughout the entire bar. The percentage might have been higher at the surface than in the center, but the prevailing temperatures as ascertained in Grennan's cupola, over 1500 degrees Cent., in hole No. 1 *(7) and averaging 1450 degrees Cent., in hole No. 2 *(8) inclines one to the belief that steel melts as steel. This is contrary to the usually accepted opinion. In all probability the carbon content of the molten steel is increased by contact with the incandescent coke through which it constantly is falling until it arrives in the well of the cupola. This does not take into account the carbon added by coming into contact with the drip from the molten pig iron or scrap above the steel. Although Grennan's observations indicate that not only the scrap from each charge, but also that of the two consecutive charges can produce this washing effect by melting simultaneously, still, it is difficult to realize that the entire surface of each piece of steel scrap is covered with the drip.

Where short pieces of medium weight steel rails, 30 to 40 kilograms per linear meter (60 to 80 pounds to the yard) are employed as part of a semisteel charge the steel melts as steel in the cupola. Carburization and subsequent melting of the successive outer surfaces does not take place until the steel arrives in the melting zone. The temperature at this point is at least 1500 degrees Cent., and, as claimed by G. K. Elliott and Dr.

From a paper presented before the International foundry congress held in Paris Sept. 12-15. The author is a Spanish engineer, member Association Technique de la Fonderie, American Foundrymen's association, Institute of British Foundrymen and Iron & Steel institute.

1 (*) U. S. A. Bureau of Mines, Bulletin 54. "Foundry-Cupola Gases and Temperatures."

2 (*) THE FOUNDRY, May 1, 1923.

3 (*) Visual observation of melting in a cupola. Paper read at the Cleveland convention of the American Foundrymen's association.

4 (*) "Donnes Pratiques sur la Conduite du Cubilot." *La Fonderie Moderne*, March, 1923.

5 (*) "Semi-steel." Birmingham conference 1922.

6 (*) "The Blast Furnace and the Foundry Cupola." *Foundry Trade Journal*, 13-IV-1923.

7 (*) 21 inches above the tuyeres.

8 (*) 27 inches above the tuyeres.

Moldenke, it sometimes is 2200 degrees Cent. Nothing could prevent the rail butts from melting there and then. The author has used this species of steel scrap on many occasions and the resulting iron showed no evidence of oxidation which would seem to indicate that melting has creased before the steel arrives at the free oxygen zone.

Under these conditions it does not seem probable that the steel should melt before the pig iron. J. Cameron's (9) experience on Armistice day and Prof. A. Campion's observation on steel melting in the cupola probably owed their origin to the fact that thin pieces of steel scrap were employed. Obviously thin sheet steel presents a greater surface area than heavy scrap to the carburizing effect of the coke and gas. Iron melting in the cupola is a far older process than steel melting in the same medium and yet various phenomena are still unexplained. Dr. Moldenke *(10) refers to highly interesting experiments carried out in an open-hearth furnace with metals of identical analysis but presenting a dead-gray and a dead-white fracture respectively. Although the atmosphere in the open-hearth differs from that in the cupola the characteristic manner in which melting takes place in both instances is highly instructive. The only regrettable feature of the account as set down in Dr. Moldenke's text book is that with the exception of carbon the temperatures and percentages of the various elements are not given. The only information conveyed by the text is that the dead-white iron was chill cast and high in combined carbon while the dead-gray iron was cast in sand molds and therefore presumably high in graphitic carbon. Current opinion is confirmed by a description of the difference observed in the melting behavior of the two irons. The hard iron simply absorbs the necessary amount of heat while the soft iron goes through a preliminary transformation in which the graphitic carbon is dissolved in the impure matrix by which it is surrounded, while being melted in the cupola. Knowing the melting point of this matrix, probably low in combined carbon, would be of great benefit and the same is true of its variations for different contents of the remaining elements found in cast iron. A still more important point is to determine as accurately as possible the temperature at which the graphite begins to change to cementite, and also to determine if there is not another intermediate state not yet defined. This is essential information.

The author has wondered whether the catalytic action of CO and CO_2 forwarded by Prof. Kotaro Honda (*) 11 might contribute—supposing it were reversible—to explain the solution of graphite in iron; but there seem to be a lot of difficulties when trying to couple this still uncertain theory to the melting of dead-gray iron in the cupola.

The phenomenon observed by Dr. Moldenke of the whole mass becoming suddenly liquid after its softening and flattening, might perhaps furnish an explanation founded on the fact that as the throwing out of solution of graphite in cooling gives up heat, its absorption by the impure steel matrix takes in heat while it is completed through the whole mass to such an extent that the prevailing temperature meets the melting point of the newly-formed alloy with the new percentage of combined carbon, when melting takes place suddenly. The previous softening and flattening might then be explained by the molecules drawing together as graphite gradually disappears, from the cellules originally filled up by it. Perhaps this tentative explanation may prove erroneous, but it seems at first sight more accurate than the surmise, widely spread, that the graphite is not absorbed by the matrix until this latter is thoroughly melted; not only because its melting point is necessarily high—as on the contrary it should migrate from the pig-iron like the eutectic phosphide—but also because it is difficult to admit a sudden solution of all the original graphite into the drops which, owing to their greater density should quickly outrun it in falling. Concerning the utility of the cupola for superheating molten metal originated from chillcast pig-iron, I think with Mr. Felton that "the great distance it drops through the hot zones gives it enough superheat to make up for the lower melting point," but the question is: How is this superheating accomplished? By simple conduction, or by silicon and manganese being oxidized below the connected CO_2 zone of Mr. Felton? This is another of the missing links to be looked into by prominent bodies such as the British Cast Iron Research association and the U. S. bureau of mines, both of which are devoted to this sort of work and have the necessary means to conduct the research.

The Norton Co., Worcester, Mass., has practically completed one of its grain storage buildings, construction work having been discontinued two years ago. The new building will afford an additional grain storage space of 1800 tons. Another plant extension consists of a one-story building 50 x 100 feet for housing the fine grain department.

9 (*) Discussion of Mr. Cameron's Paper on Semi-steel.

10 (*) "Principles of Iron Founding" page 99.

11 (*) "On the constitutional diagram of the iron-carbon system based on recent investigations" Journal of the Iron and Steel Institute. 1922-No. 1.

Facilitates Molding by Changing Corebox

By M. E. Duggan

Had the young men with two years' experience in the pattern shop, spent the first six months in the foundry and the succeeding year and a half in the pattern shop, he would have made a better job of the pattern for a catch basin shown in the accompanying illustration. Usually these castings are in the shape of a plain rectangular frame and are provided with a flat perforated cover through which the waste water enters the sewer. In this instance a change in design was required to conform to certain changes in the general layout of the sewer system. The special casting was to present water inlets on all four sides and was to be covered on top with a plain cast iron plate. The engineering department decided that the regular pattern would serve to make six castings if suitable core prints were attached to the sides to form the openings.

Eleven openings were specified on each side and seven openings on each end of the casting. Instead of attaching individual tail prints for each core it was decided to attach a plain slab print on each of the four sides of the pattern and then make four slab cores with suitable projections to form the openings.

The pattern first was prepared with a core print as shown at *B* attached to the outside of the pattern and carefully rounded on the upper inner corner to fit closely in the fillet of the casting. The extra work involved in fitting the print in this manner represented a waste of time, but the most objectionable feature in this print was that it was not *drafted* on the outside. This caused trouble in drawing the pattern out of the sand and caused further trouble when an attempt was made to lower the cores into place. The foundry superintendent had the pattern refitted with interior core prints as shown at *A*.

The print was extended to a point that brought it flush with the cope face of the pattern and also was drafted liberally on the back so that the cores could drop down easily into place and also insured that both front and back of the core would fit tightly against the two walls of the mold. This feature alone offset the cost of changing the pattern since it eliminated the necessity of chipping fins from the outside face of the various openings. The six castings contained 216 openings.

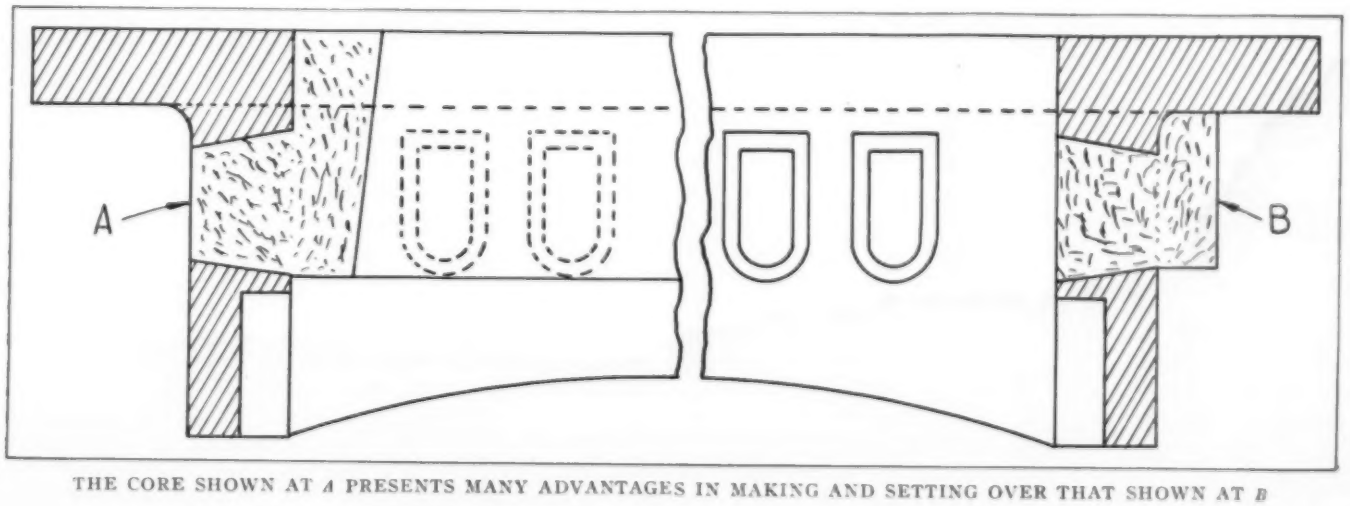
The sides of the castings were approximately twice as long as the ends and also nearly twice as thick. The sides were provided with 11 openings each and the ends with seven. This arrangement presented such an apparently serious problem to the young patternmaker that he made two coreboxes, one for the side cores and one for the end cores. He also decided that a one-part corebox could not be removed from the core and, therefore, he split each box longitudinally through the center so that the coremaker could draw the halves away laterally after the core was rolled onto the plate. The idea of lifting the corebox straight up from the core did not occur to him.

In the revised version a one-piece corebox provided with suitable stop-off pieces served to make both side and end cores. The box was used in its entire length for the side cores. The end cores also were rammed in the full length box, but before the corebox was rolled on to the plate the coremaker ran his trowel through the sand at two points indicated by suitable marks on the box. After the corebox was removed from the core the excess portion of sand beyond the marks was scraped away and returned to the sand pile. In this manner the shorter cores were prepared for the ends of the mold. The thickness of the slab part of the core was the same for the end and the side, but on account of the difference in the metal thickness of these two parts of the casting it was necessary to reduce the length of the projecting parts of the core. This was accomplished by placing thickness pieces of wood in the corebox pockets before they were filled with sand.

Book Review

American Society for Testing Materials Tentative Standards, 1923, 859 pages, paper or cloth, 6 x 9; published by the American Society for Testing Materials, Philadelphia, and supplied by THE FOUNDRY, Cleveland; price $7.00 in paper and $8.00 in cloth binding.

Tentative standards are those specifications and methods which are published by the society for at least a year before their adoption as standard with a view of obtaining criticism of which the respective committees take cognizance before recommending the specifications for final adoption as standard. The present volume contains 170 such tentative standards many of which are of vital interest to the foundryman. Of the 23 tentative standards relating to ferrous metals, and the 12 relating to nonferrous metals, the foundryman is particularly interested in those for steel castings, for carbon-steel castings for railroads, for electric cast-steel anchor chain, for foundry pig iron, for chilled cast-iron wheels, and for high-test gray-iron castings, besides several tentative standards for babbitt metal, aluminum ingots, etc. Methods of heat treating carbon-steel castings are outlined and methods given for the analysis of carbon steel, alloy steel and pig lead. Among the other classifications which have an interest for the foundryman are specifications for coal and coke, and pertoleum products and lubricants.



THE CORE SHOWN AT *A* PRESENTS MANY ADVANTAGES IN MAKING AND SETTING OVER THAT SHOWN AT *B*

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Prompt Action Is Needed

FROM a practical standpoint, one of the most important steps taken at the International Foundrymen's congress in Paris in September is embodied in the resolutions on testing cast iron which were published on page 817 of the Oct. 15 issue of THE FOUNDRY. These resolutions, which were passed unanimously, point the necessity for international agreement on standard methods of testing and suggest a plan for bringing the proposed international specifications actually into being. Up to the present nothing has been done except to put forward an idea, which foundrymen all over the world have agreed should be given practical effect. What is wanted now is action.

The resolutions adopted at Paris propose the formation of an international committee, consisting of delegates from the existing committees on tests of the several national associations. This international committee is to take up, first a method of testing the quality of iron going into castings, and second the quality of the castings themselves. Nearly everyone is agreed that these objects are desirable, but unless the recommendations of the Paris congress are definitely acted upon, the whole project is in danger of falling to the ground. At present, the international committee does not even exist officially. Some one association must start the ball rolling. This task should be undertaken by the American Foundrymen's association.

If the work is to succeed, several definite steps are necessary. First, the members of the international committee should be appointed officially. They should be men of broad experience, who can give some time and perhaps money to the work, and they should be given authority to act on behalf of their respective associations. This committee next must appoint a chairman who will direct and a secretary who will work. Following this, each association could be asked to submit its recommendations to the secretary, who should embody the whole in a monograph for general circulation. The proposals, which will show wide divergence, can then be discussed by mail. After, but not until this preliminary work is done, the committee should hold a meeting, preferably before the end of 1924, at which time the differences can be discussed verbally and an international standard method of testing cast iron adopted by a majority vote. Then it should be the final duty of the members of the committee to sink their own ideas and induce their several associations to ratify the standard method. Only when it is ratified by three or more of the asssociations concerned can the job be considered finished.

This is no small program, but with effort and good will it can be done. The task should be carried out with the fullest publicity so the foundrymen of the world may learn something of what it means to put over an international agreement, even on a relatively simple subject. In addition to its great value to the foundry industry, this work will be an object lesson in international politics. It will tend to promote real understanding among a group of men, engineers and business leaders, who as a class are going to be largely responsible in the future for the peace of the world. Thus not only science, but the comity of nations will be served.

Trade Outlook in the Foundry Industry

EVERY contributing factor points to further development in castings demand through the remainder of the present year. Even those lines which were expected to slacken with the coming of winter show new life. Railroad buying which has formed an important feature in relation to the foundry industry is renewed. Automobile manufacture which normally might be expected to slacken, continues practically without interruption. Building construction is taking on new life. Cast-iron pipe sales are increasing. Textile machinery orders have speeded up in the past month. Contracts for electrical machinery and engines are multiplying. Even machine tools are displaying greater activity recently.

Railroads Important

As an index to business conditions in general, and a dominant influence in the commercial lives of a great many foundries, the railways of the country have taken on new importance during the past year. An unprecedented record of twenty-one consecutive weeks with more than a million cars a week loaded with revenue producing freight, marks 1923 as unique. The week ending Nov. 20, although past the peak of the year, from the standpoint of freight shipments, showed a total of 1,036,067 cars loaded. The total capital expenditures for railway equipment during the present year will exceed $1,059,440,000 and appropriations of over $243,000,000 will be carried over into next year. Car buying increased slightly in October, and inquiry for over 18,000 cars is reported in Chicago. Unfilled orders for locomotives in October totaled 915, while new inquiries have appeared in November. Further, railroads are buying machine tools and these are supplemented by inquiries from shops specializing in railway repair work. Next year is expected to bring forth extensions in bridges, buildings and other maintenance-of-way items.

Prices of Raw Materials for Foundry Use

CORRECTED TO NOV. 23

Iron		Scrap	
No. 2 Foundry, Valley	$24.00 to 25.00	Heavy melting steel, Valley	$15.75 to 16.00
No. 2 Southern, Birmingham	19.00 to 20.00	Heavy melting steel, Pitts	16.00 to 16.50
No. 2 Foundry, Chicago	23.00	Heavy melting steel, Chicago	14.00 to 14.50
No. 2 Foundry, Philadelphia	22.26 to 23.26	Stove plate, Chicago	17.50 to 18.00
No. 2 Foundry, Buffalo	19.50 to 20.00	No. 1 cast, Chicago	21.00 to 21.50
Basic, Valley	20.00 to 21.00	No. 1 cast, Philadelphia	19.00 to 20.00
Basic, Buffalo	20.00	No. 1 cast, Birmingham	19.00 to 20.00
Malleable, Chicago	23.00	No. 1 cast, Buffalo	18.00 to 19.00
Malleable, Buffalo	19.50 to 20.00	Car wheels, iron, Pittsburgh	17.50 to 18.00
Coke		Car wheels, iron, Chicago	18.00 to 18.50
Connellsville foundry, coke	5.00 to 6.00	Railroad malleable, Chicago	19.00 to 19.50
Wise county foundry, coke	5.50 to 6.00	Agricultural mal., Chicago	18.00 to 18.50
		Malleable, Buffalo	17.00 to 18.00

Iron Buying Starts

The two weeks ending Nov. 24 saw a resumption of buying in pig iron. Many large users had deferred their purchases and stocks in many cases were exceedingly low, when several of the larger melters came in the market for tonnages sufficient for the remainder of the year, or in many cases contracted for some first quarter shipments. Conservative estimates place the total of iron contracted within about one week at more than 700,000 tons, the largest buying volume since March, 1923. Prices apparently have touched bottom and rebounded. Radiator, sanitary-ware interests and pipe foundries have been the heaviest purchasers, although a great amount of malleable has been sold. Stocks on hand in foundry yards have shown a steady decline during the fall, October probably constituting the low point for the average throughout the country, in both pig iron and scrap. Coke sales are increasing, but prices remain practically unchanged. Shipping conditions have remained favorable, and in consequence many foundries have depended upon prompt, spot-shipment iron to meet their immediate requirements.

Conditions Sound

Building operations have shown surprising strength throughout the fall. October registered a slight gain over September, a condition practically unprecedented. Residential awards have been the main source of gain, and this in turn is reflected in the continued heavy demand for heating and plumbing goods, building hardware and domestic sundries. October sales of steel castings, according to the department of commerce, registered a decline. Bookings for that month totaled 37,446 tons as reported by companies representing over two-thirds of the total capacity of commercial steel castings production. This total represents only 38.6 per cent of the capacity of the plants reporting, Railway steel castings bookings were responsible for the decline, the total contracted in this line representing only 25.7 per cent of capacity, while the miscellaneous castings increased from 44.2 per cent in September to 47.1 per cent of capacity in October. The Ohio State Foundrymen's association reports ferrous foundry operations in the state to be on the basis of 68.14 per cent of capacity, a decline from the September rate of 71.51 per cent. Nonferrous foundries in October were at 55 per cent compared with 60 per cent for the previous month. Textile machinery sales in the East have increased and have exerted a direct influence upon the castings demand in that section. Malleable operations throughout the country average about 55 per cent. Automobile production continues to bring a strong castings demand. Many automobile shops are operating at full capacity, and the December lull may not be encountered. October production of automobiles was 365,107, according to the department of commerce. This represents a gain of 37,564 over the previous month, or an increase of 11 per cent in the rate of output. Sales are reported at an unusually high level.

Nonferrous Operations

Brass and aluminum foundries catering to the automotive industry are active, while the demand for plumbers' goods continues strong. Prices for nonferrous metals based on New York quotations in the *Daily Metal Trade* of Nov. 23 follow: Electrolytic copper, 13.00c to 13.25c; casting copper, 12.75c; Straits tin, 44.87½c; lead, 6.85c; antimony, 8.87½c to 8.90c; nickel, producers price, 32.00c; aluminum, No. 12 alloy, open market, 21.50c to 22.00c. Zinc is 6.27½c to 6.30c, E. St. Louis.

Comings and Goings of Foundrymen

FRANK LITTLE has leased the foundry of the Portable Tool Co., Monroeton, Pa., having recently resigned from the Elmira Foundry Co., Elmira, N. Y. Mr. Little's long experience in the foundry industry started with his first employment at the Blood Foundry, Athens, Pa. when he was 12 years old. After a number of years' employment in various railway foundries and specialty shops, Mr. Little took charge of the Blood shop where he started to learn his trade. Later he had charge of the Atlantic Coast Lumber Co. foundry, Georgetown, S. C. He was employed by the Weiskittle & Son Co., Baltimore, after which he started the Athens Foundry Co., Athens, Pa. Later he was in charge of the following foundries: National Car Wheel Co., Sayre, Pa.; Gould Pump Works, Seneca Falls, N. Y.; Clebourne Foundry Co., Clebourne, Texas; and Catchpole Foundry, Geneva, N. Y.

W. A. Markwell has been made general foundry foreman of the Kansas City Hay Press Co., Kansas City, Mo.

Thomas P. Anthony has been appointed chief engineer for the United States Cast Iron Pipe & Foundry Co., Burlington, N. J.

P. T. Laws has been appointed southern district manager for the United States Cast Iron Pipe & Foundry Co., Burlington, N. J. Mr. Laws will be located at the American Trust & Savings Bank building, Birmingham, Ala.

P. R. Ramp, formerly connected with the Union Steam Pump Co., Battle Creek, Mich., has been appointed superintendent of the H. & B. American Machine Co., Pawtucket, R. I., and has taken charge of all its foundry operations.

Frank Evans has resigned his position as pattern supervisor for the Hupmobile Motor Co., Detroit, Mich., following 11 years continuous employment in that position. Mr. Evans plans an extended trip to the South before announcing his future connection.

Harry J. Rothrock has been made assistant foundry superintendent for the Deemer Steel Casting Co., New Castle, Del. For the last four years Mr. Rothrock has been connected with Taylor Wharton Iron & Steel Co., and during two years of that time was superintendent of the steel foundry department at Easton, Pa.

E. H. Werner, formerly with the United Engineering & Foundry Co., Pittsburgh, has resigned from that company to become chief engineer of the Granite City steel works of the National Enameling & Stamping Co. Mr. Werner was in charge of construction of the new sheet mill of the National company at Granite City.

Stanley A. Richardson has returned to the faculty of the department of engineering of Lewis Institute, Chicago, and has resumed charge of the work offered in metallurgy and metallography. Plans have been made for the addition to the foundry equipment of a small electric furnace for steel making, which is to be constructed in large part by students in the department.

Addressed New England Foundry Group

Under the heading of relativity of elements in castings, E. J. Lowry, metallurgist of Hickman Williams & Co., Inc., Cincinnati, described a series of exhaustive tests to the New England foundrymen at their regular monthly meeting held Nov. 14 at the Exchange club, Boston. Mr. Lowry has made several thousand tests of castings to determine effect of varying proportions of different metals and from these tests he selected 8 or 10 graphs which he threw on the screen and explained. He said that some years ago the silicon content was taken as an indication of strength and softness of castings, but that it was now known that other elements and their proportion as compared with silicon are of the utmost importance in determining these two qualities.

One graph illustrating variation in carbon showed the maximum strength to be reached at carbon 3.00 per cent. From this point the strength fell off rapidly to a low point at carbon 3.50 per cent. The relation of sulphur and manganese was shown with several slides. Mr. Lowry said that the old formula of two times the sulphur plus 0.15 for the amount of manganese should be doubled. Thus if sulphur is 0.10 by the old formula manganese should be 0.35 and by the new formula 0.70. Several charts illustrated effect of introducing steel into the cast iron mixture. With steel content varying from 0 up to 60 per cent a gradual increase in strength was shown from 22,000 pounds per square inch at 0, to 30,000 at 40 per cent steel. From this point the strength rapidly fell off, being lower at 50 per cent than at 30 per cent. Following the discussion on effective metals in castings Mr. Lowry showed a series of interesting lantern slides of the Connellsville coke district. All varieties of ovens were included from the small hand operated ones to the large mechanical pusher type.

Georgia Division Meets

Costs as related to castings manufacture formed the most important consideration at a meeting of the Georgia division of the Southern Metal Trades association held at Columbus, Ga., Nov. 13. John S. Schofield, J. S. Schofield Co., Macon, Ga., presided and in his opening remarks touched upon the need for a careful study preliminary to establishing costs. Thomas Perkins, cost accountant for the J. S. Schofield Co. detailed examples of forms and methods of computing the various items. Twenty-eight members were registered.

Consider the Apprentice Training Problem

The Quad City Foundrymen's association held a preliminary meeting Nov. 5 at Moline, Ill., at which A. E. Hageboeck, president, enlisted the assistance and advice of the school authorities of Moline, Rock Island, East Moline and Davenport, Ia., in solving the apprentice problem. Fred Kirby, chairman of the apprenticeship committee of the association outlined the work attempted by the organization and J. F. Kolb, state supervisor of industrial education for Illinois, explained the work which the state is doing in furthering apprentice training.

The regular November meeting held Nov. 26, followed in the consideration of the same subject, the speaker being H. A. Frommelt, Falk Corp., Milwaukee, who discussed not only the foundry phases of the subject, but also considered woodworking and machine shop training.

Orton & Steinbrenner Co., 608 South Dearborn street, Chicago, manufacturer of locomotive cranes, buckets, and coal crushers, has just completed a large addition to its works at Huntington.

Obituary

Francis Fenwick, president of Fenwick Frères & Co., Paris, importers of American machinery, especially foundry equipment, died recently. Mr. Fenwick had been prominently identified with Fenwick Frères & Co. since 1885. For many years this company has been agent in France and Belgium for the Tabor Mfg. Co., Philadelphia.

Clarence Renshaw, aged 49, electrical engineer of Pittsburgh, and vice chairman of the Democratic state committee, died Oct. 22 in his home in that city. For the last three years Mr. Renshaw had been associated with the National Metal Moulding Co., and for the previous 2 years with the Westinghouse Electric & Mfg. Co. During the war he was a member of the Fuel Conservation commission at Washington. He was born in Baltimore, Md., and was a graduate of the Baltimore city college, and received his engineering degree at the Massachusetts Institute of Technology in 1899.

William P. Clark died at his home in Belmont, N. Y., recently. Mr. Clark was born in Unadilla Forks, N. Y., March 11, 1851. In 1877 he was made manager of the D. Rawson Works, later reorganized as A. W. Miner & Co., Belmont, manufacturers of agricultural implements. In 1880, with his brother, Mr. Clark organized the firm of Clark Brothers, Belmont, which developed into a large manufacturing company making saw mill equipment. This company later was moved to Olean, N. Y. In 1917, Mr. Clark organized the Clark Tool Works, Inc., Belmont, for the manufacture of metal cutting band saws and general machine tools. Mr. Clark is survived by his wife, four daughters, two sons and eleven grandchildren.

A Small Cupola Must Be Carefully Charged

Question: Some time ago a writer in THE FOUNDRY stated that a small cupola from 20 to 30 inches diameter could be kept in blast all day and further that this was common practice in some foundries. I am interested in knowing how it is done.

Answer: A small cupola can be operated continuously all day if it is kept clean. The only way to keep it clean is to use the proper proportion of coke and iron in each charge, a mild blast that will supply sufficient oxygen to consume the fuel and yet not chill the material in the vicinity of the tuyeres, and a suitable quantity of fluxing material that will produce a liquid slag that will flow readily through the slag hole. These various factors will vary according to the diameter of the cupola. Comparatively heavy charges may be employed where a cupola only is in blast for one or two hours; but where continuous melting over a period of six hours or more is required, the charges must be reduced. For example, 2000 pounds of iron may be charged on the bed of a 30-inch cupola, followed by six or seven 1500-pound charges where this amount represents the total heat. However, the cupola will be partly, and in some cases almost completely choked at the close of the melting period. By reducing the iron charges to 500 or 600 pounds each and by observing the precautions previously outlined, melting may be continued for a reasonable time before trouble is encountered.

Dr. Stead Died

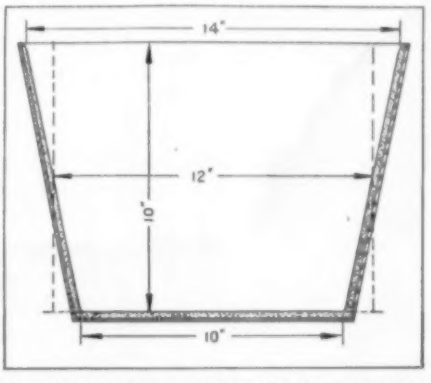
Dr. John Edward Stead, past president of the Iron and Steel institute and bessemer medalist of the institute, died Oct. 31, at his home in Redcar, Yorkshire, England, at the age of 72 years. For many years Dr. Stead had been a prominent figure in the Iron and Steel institute. He was born Oct. 17, 1851, at Howden-on-Tyne. Because of frailness in his early youth his education until 14 years of age was under his father's care. He began his industrial career as a ship chandler from which trade he went into chemistry. In 1871 he became chemist for Bolckow, Vaughan & Co., Ltd. In the five succeeding years he studied the practical side of metallurgy, including the blast furnace, the puddling process, bessemer steel production, foundry practice and coke making. In 1876 he formed the partnership of Pattinson & Stead with John Pattinson, his former chief and teacher. Dr. Stead was elected to the Iron and Steel Institute in 1873 and had devoted much of his time thereafter to the institute's work. He was elected a fellow of the Institute of Chemistry in 1877, became a life member of the Physical society in 1881, member of the Chemical society in 1882, president of the Cleveland Institution of Engineers in 1895; member of the council of the Iron and Steel institute in 1895; honorary member of the West of Scotland Iron and Steel institute; was awarded the bessemer medal by the Iron and Steel institute in 1902; made a fellow of the Royal society in 1903; received gold medal from the committee of the St. Louis exhibition in 1904; elected an honorary member of Sheffield Society of Engineers and Metallurgists in 1905; received life membership awarded by the American Society of Mining Engineers in 1906; was elected president of the chemistry B section of the British association in 1910; and also has been accorded honorary membership in the British Foundrymen's association. The honorary degree of doctor of metallurgy was conferred by the Leeds university in 1912 and by the Victoria university of Manchester in 1914.

Ready Method of Finding Ladle Capacity

Question: Recently I received a bulletin from a foundry supply house containing among other items of information a table for quickly figuring the capacity of iron ladles. My early education was neglected and while no doubt the information is all that it should be, still I am unable to understand it. I am enclosing the table and will appreciate your kindness in showing me how to read it.

Answer: The table is based on the fact that a circular plate of iron 1 inch thick weighs a definite amount. It gives the weight of a circular plate 1 inch thick in diameters from 12 to 144 inches. Thus you will note that the diameter is given in inches in one column and the weight in pounds is shown opposite in the following column. For example a 12-inch diameter plate weighs 29½ pounds, a 13-inch diameter plate weighs 35 pounds and so on down the list. When you have found the weight of 1 inch of iron in the ladle you easily may find the total capacity by multiplying the figure representing the 1 inch by whatever figure represents the depth of the ladle. The method of working the example is shown in the accompanying illustration.

The diameter at the top of the ladle is 14 inches and the diameter at the



SECTIONAL VIEW OF LADLE SHOWING APPLICATION OF THE RULE FOR FINDING THE CAPACITY

bottom is 10 inches. It is apparent that if the capacity of the ladle is figured from a 14-inch base it will be too great. If it is figured from the 10-inch diameter it will be too small. To find what is known as the mean or common diameter add the figures representing the top and bottom diameters together and divide the result by 2. In this instance the formula will be shown 14+10÷2=12. Referring to the table you will note that a 12-inch round plate weighs 29½ pounds. Therefore if the ladle is 10 inches deep the total capacity will be 29½ x 10= 295 pounds.

Bond for Cut-Off Wheel

Superior bonding properties are claimed for an agent developed by the Carborundum Co., Niagara Falls, N. Y., and incorporated in the manufacture of its cut-off wheels. It is stated that this material which is a phenol resin of the same family as bakelite, when combined with one of the company's abrasives forms an ideal combination. A wheel bonded with this material presents the combined virtues of strength, porosity, hardness and heat resistance. It will not soften or melt and insures a free clean cutting wheel, one that will cut without binding. General practice favors 12-inch diameter wheels for cut-off work. Wheels are made in various thickness and sizes down to a minimum thickness of 3/32 inch. Popular sizes include 12 x 3/32 inch and 12 x ⅛ inch.

Rolls Poured with Motor Operated Ladle

Experience of a large middle western roll shop extending over a period of a year would seem to indicate that the ladle shown in the accompanying illustration, equipped with a motor for operating the tipping gear, is practical and in some respects an improvement on the type formerly employed where a man was obliged to stand on an improvised platform and operate the tipping mechanism through a hand wheel. The ladle has a capacity of 30 tons and it is stated that the flow of metal may be regulated from a tiny stream to a volume that will fill a mold at the rate of 20 tons per minute. This feature is of particular interest to roll founders where the metal usually is poured rapidly and in large quantities. The motor is controlled from the crane cage and it is claimed that by this method whereby all the operations incident to pouring the ladle are placed in the hands of one man, more uniform results are obtained that where two or more men are responsible. Attention also is directed to the comparative safety of the workmen involved in pouring the metal. Instead of crowding up close on a temporary and sometimes wobbly platform, three or four workmen stand at a safe distance on the floor and steady the ladle with long bars. The craneman from his cage at a safe distance, tips the ladle and regulates the speed at which the metal is poured into the mold. The ladle was supplied by the Whiting Corp., Harvey, Ill., and in addition to the motor is equipped with the helical worm gearing which this company has developed and placed on all its crane ladles.

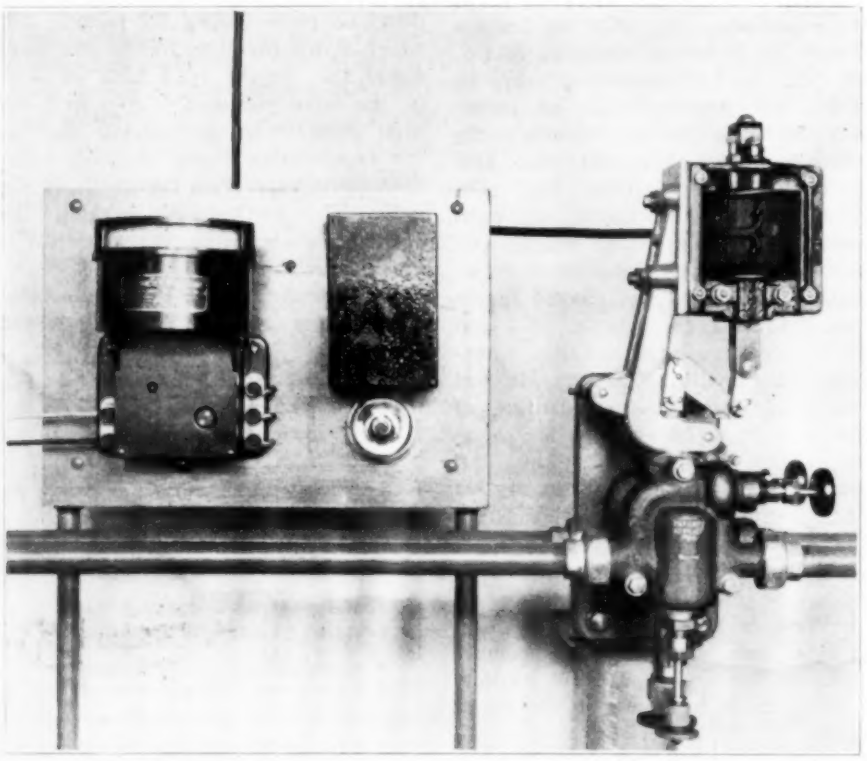
THE POURING DEVICE IS OPERATED BY A SMALL ENCLOSED MOTOR CONTROLLED FROM THE CRANE CAGE

Has Developed Automatic Burner Control

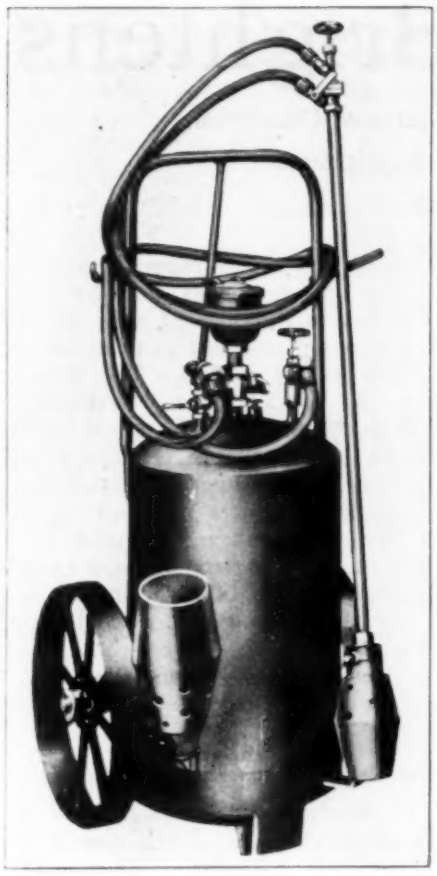
F. J. Ryan & Co., Philadelphia, have designed an automatic temperature control for oil and gas-fired furnaces. The unit, shown in the accompanying illustration, consists of a specially designed valve operating in conjunction with a magnet, the movement impulse originating in a thermocouple within the heating chamber, and connected through a recording or indicating pyrometer and control panel. The control is designed so that it may operate either a single or multiple set of burners with control of a single temperature, or different stages of temperature within a single zone. It is adapted to continuous furnaces where varying temperatures are demanded.

In endeavoring to avoid the use of delicate wearing parts the magnet impulse for the control of the valve was developed. The control is adaptable to either high or low pressure burners, or to any type using either gas or oil, or a combination of gas and oil, with operation in conjunction with the usual type of pyrometric control.

Not only does the company claim that accurate temperature control is



AUTOMATIC BURNER REGULATOR CONNECTED WITH PYROMETRIC CONTROL



TORCH BUILT FOR WORK IN CAR SHOPS

secured by the apparatus, but it also states that a saving is effected in the reduction of fuel consumed, the elimination of labor necessary for burner operation, reduction of refractory erosion due to overheating, and an increase of production per unit when compared with average operation.

Introduces Oil Burning Torches and Forges

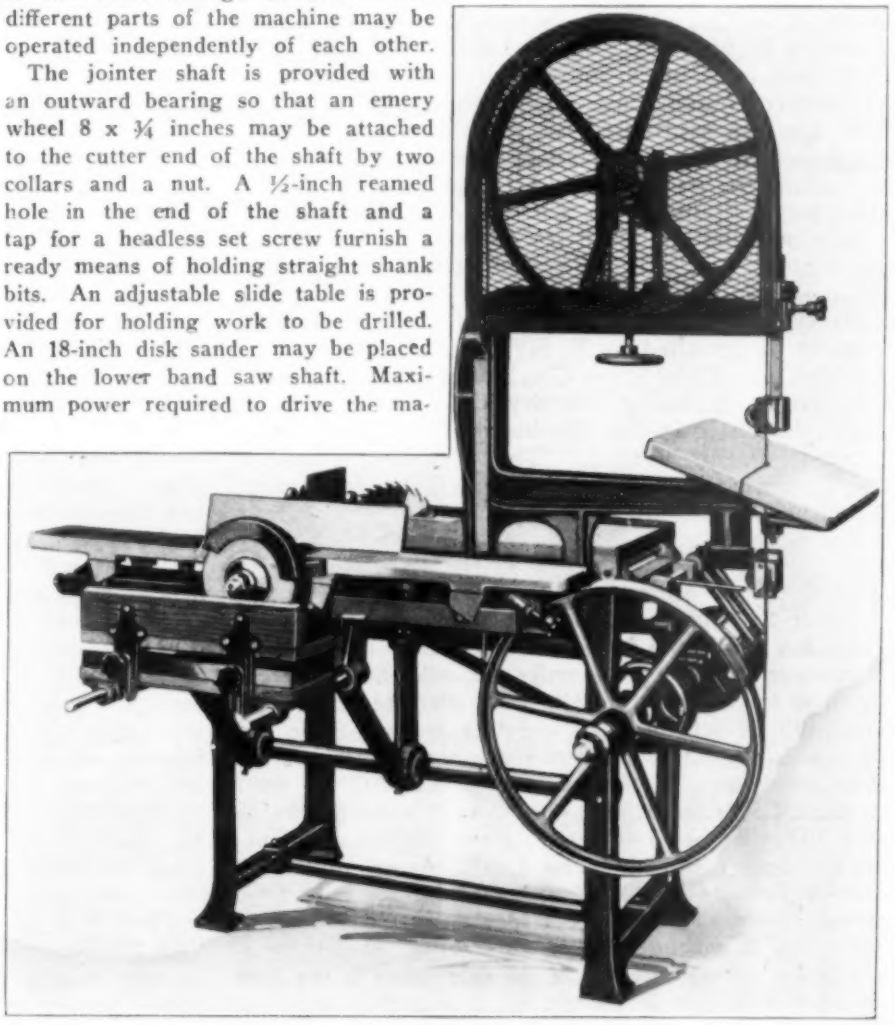
A new line of oil burning industrial heating apparatus has been introduced by the Johnston Mfg. Co., Minneapolis. Among the articles being placed on the market are rivet forges of the portable type designed especially for use in car repair shops, structural shops and boiler shops, oil burning torches and pressure blowers. A view of the oil burning torch is shown in the accompanying illustration.

The oil burning torch is designed to burn either fuel oil or lighter oils. The large nozzle operates from a small flame 12 inches long to the large flame required for firing a locomotive boiler for a steam test. Principal uses for this machine are found in car repair work, firing locomotives for steam test and for starting fires in locomotives.

Woodworking Machine Has New Feature

Some interesting features recently have been added to the combination woodworker shown in the accompanying illustration and made by the Buffalo Forge Co., Buffalo. The principal changes have been made in the planer guide arrangement providing for quicker, simpler and more accurate adjustment and in the introduction of a positive drive for rip saw and jointer mandrel through a rawhide pinion and gear. The new planer guide consists of a slide through which the planer guide is moved forward and backward in a slot. The guide is locked in position with one thumb nut. The twisted belt on the drive shaft has been replaced by a positive gear and pinion drive which eliminates belt slippage and results in a smoother machine. The gear ratio of the two pinions approximately is 2 to 1. The 1-inch drive shaft runs in babbitted, reamed bearings split for adjustment. The pulley for the jointer and the lower band-saw wheel are connected to this shaft through clutches. The different parts of the machine may be operated independently of each other.

The jointer shaft is provided with an outward bearing so that an emery wheel 8 x ¾ inches may be attached to the cutter end of the shaft by two collars and a nut. A ½-inch reamed hole in the end of the shaft and a tap for a headless set screw furnish a ready means of holding straight shank bits. An adjustable slide table is provided for holding work to be drilled. An 18-inch disk sander may be placed on the lower band saw shaft. Maximum power required to drive the machine is from 1 to 2 horsepower for the band saw and up to 3 horsepower for the rip saw. The drive shaft should be run at about 700 revolutions per minute.



THIS MACHINE COMBINES PRACTICALLY EVERY DEVICE NEEDED IN A PATTERN SHOP WITH THE EXCEPTION OF A LATHE

Make Industrial Film

A motion picture entitled "America's Industries" is in the course of preparation by the Tide Water Oil Sales Corp., 11 Broadway, New York. The company announces that the film soon will be ready for exhibition before the various engineering organizations and societies. The film will show the equipment and practice in various industries including plants of the United States Steel Corp., and Alpha Portland Cement Co., Stone & Webster, Inc., the Chicago Railway Equipment Co., the National Electric Light association, the Connonwealth Steel Co., the Emergency Fleet Corp., the American Rolling Mill Co. and others.

Edwin Peterson, Houston, Minn., is planning to erect a foundry in that city.

Equipment Outlook Brightens

Sales of Repair and Replacement Parts Serve as Barometer of Conditions in Foundry Machinery Lines—Cleaning Room Equipment Active—Some Orders Await New Year

NEW activity is noted in the purchase of foundry equipment. A manufacturer of sand handling and mixing machinery reports larger repair and replacement orders than ever has been received at one time in the company's history. Further, new inquiries are noted, some of which originate on the Pacific coast. The Galion Iron & Mfg. Co., Galion, O., contemplates the erection of a new gray iron and a new steel foundry. Holmes Foundry Co., Port Huron, Mich., is adding considerable new equipment. This company has purchased two shakeout bales from the Stoney Foundry Engineering & Equipment Co., Cleveland. Other sales of shakeout equipment by the latter company include two to the Dayton Steel Foundry Co., Dayton, O., and one each to A. Weiskittle & Sons Co., Baltimore, and Emerson-Brantingham Co., Rockford, Ill. The Stoney company is engaged in the redesign of the foundry of the Davenport Locomotive Works, Davenport, Ia., where a continuous pouring system is to be installed. Cadillac Motor Car Co., Detroit, has contracted with the Foundry Equipment Co., Cleveland, for a battery of 31 core oven units, individually oil fired through an inter-communicating tunnel. The American Radiator Co. has contracted with the Pangborn Corp., Hagerstown, Md., for sand blast and dust arrester equipment for its Springfield, O., plant. The Ferro Machine & Foundry Co. Cleveland, is constructing a new building to house its cleaning and shipping departments and will buy tumbling mills, sand blast and conveying machinery. Recent sales of tumbling mills by the W. W. Sly Mfg. Co., Cleveland, include units to be installed by F. E. Myers & Brother Co., Ashland, O.; Ohio Stove Co., Portsmouth, O.; Benton Harbor Malleable Foundry Co., Benton Harbor, Mich., Piston Ring Co., Muskegon, Mich., and Andre Citroen, Paris, France. The Peerless Foundry Co., Cincinnati, has ordered dust arrester equipment from the W. W. Sly company.

East Awaits New Year

THE past two weeks in the eastern foundry equipment have been as quiet as at any time this year. There has been more inquiry for descriptive matter, such as catalogs, etc., but little active demand. Sellers generally look for little real activity until after the end of the year, with its accompanying inventory season. Some fair business is pending, but sellers state they are having difficulty in closing. A current buyer is the Atlantic Steel Castings Co., Chester, Pa., this interest recently closing on a 10-ton trolley to an eastern crane building and figuring on some further equipment. The American Brakeshoe & Foundry Co., 30 Church street, New York City, recently noted as purchasing sand blast and dust arrester equipment, is to close shortly on a 10-ton electric overhead crane. Another buyer of the near future is the John Polachek Bronze & Iron Co., Long Island City, which recently placed a contract for the erection of a substantial addition to its foundry. The Federal Steel Co., Chester, Pa., recently lost $20,000 by fire, and is expected to be a small buyer shortly. The W. J. Collins Foundry Co., Milford, Mass., recently has been organized with W. J. Collins president, and is expected to announce plans shortly concerning the establishment of a plant. The Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., will start work soon on the erection of a 46 x 50-foot addition to its power plant. Quotations on foundry equipment generally are unchanged, although one seller of sand blast equipment announces there will be an advance in some sizes Dec. 1. An advance in pitch core compounds appears likely in some quarters within the next few weeks. The American Saw Mill Machinery Co., Hackettstown, N. J., has placed an order for sand blast and dust arrester units with the W. W. Sly Mfg. Co., Cleveland. The Neptune Meter Co., Long Island City, N. Y., will install dust arrester equipment made by the Pangborn Corp., Hagerstown, Md.

Quiet Rules In Pittsburgh District

EQUIPMENT and machinery purchases are not now so active as a few weeks ago. Sellers believe this to be the end of the year's quiet spell, particularly noticeable before the taking of inventories when manufacturers generally withhold expenditures for improvements. Recent buyers of tumbling barrels include the following from the Whiting Corp., Harvey, Ill.; Western Electric Co., Chicago; Carr Bros. Inc., New York City; Bucyrus Co., South Milwaukee, Wis., and Manning, Maxwell & Moore, Inc., Muskegon, Mich. The Whiting Corp., also sold a cupola to the Leonard & Baker Stove Co., Taunton, Mass. Sales of flasks, riddles and other small foundry supplies have been few. Molding machine orders are not coming in as briskly as anticipated, so many of the foundry operators who recently put out inquiries continuing their policy of deferring action. The largest order reported by the Herman Pneumatic Machine Co., Zelienople, Pa., is that of the Commonwealth Steel Co., Granite City, Ill., four machines. Richardson & Boynton Co., Dover, N. J., bought two large machines and the Industrial Works, Bay City, Mich., as well as the Valley Mold & Iron Corp., Sharpsville, Pa., each bought one, the latter for jarring ingot molds. Many molding machine orders are held in abeyance, several foundries awaiting the working out of present orders to present a breathing spell either before or shortly after the end of the present year in which they will revamp and improve their equipment layouts. Molding machine manufacturers report that prospective purchases and promises of early action never were so numerous. The largest crane purchase pending is that of the Standard Sanitary Mfg. Co., for its new plant at Baltimore, Md., for which it also is purchasing large quantities of core ovens, cupolas, tumbling barrels, grinding machines, etc. The crane inquiry calls for six, 5-ton special foundry cranes and one 5-ton electric overhead crane for the machine shop. The Westinghouse Electric & Mfg. Co., East Pittsburgh, recently bought several cranes, three being awarded a middle western crane building and one for Philadelphia going to the Milwaukee Electric Crane & Mfg. Co., Milwaukee. The Harrison Radiator Co., Lockport, N. Y.,

bought a 10-ton crane from an unnamed builder. The Erie Forge Co., Erie, Pa., and the American Elevator & Machine Co., Inc., Louisville, Ky., have placed orders for dust arrester equipment with the Pangborn Corp., Hagerstown, Md. The latter also contracted for sand blast machinery with the same firm. The Florin Foundry & Mfg. Co., Florin, Pa., has been incorporated by A. E. Koch and others.

Interest Evident In New England

BUYING of equipment in New England is on a relatively small scale. The foundries catering to the hardware trade in Connecticut are swamped with orders and several of these have been in the market recently for molding machines, grinding tools, small cranes and similar equipment. Recent buyers along various lines include the H. & B. American Machine Co., Pawtucket, R. I.; Hunt Spiller Corp., Boston; Walworth Mfg. Co., Boston, and Taylor & Fenn Co., Harford. The General Electric Co., Lynn, Mass., recently has bought a 25-ton crane for its foundry. This company is considering considerable other foundry equipment. The Bullard Machine Tool Co., Bridgeport, Conn., has been rehabilitating an idle part of its foundry and is understood to still be in the market for some equipment. The Spencer Turbine Co., Hartford, Conn., is installing a large blower capable of delivering 14,000 cubic feet of air per minute at the plant of the Singer Mfg. Co., Elizabeth, N. J. The Studebaker Corp. of America has placed orders for three blowers of 11,000 cubic feet per minute capacity each with the Spencer Turbine Co.

Inquiries Greater In Chicago

INQUIRY for many lines of foundry equipment is heavier but in most cases it appears purchasing is to be postponed until after the turn of the year. The Whiting Corp. has sold two tumbling barrels to the Mt. Vernon Furnace & Mfg. Co., Mt. Vernon, Ill.; two barrels to the Marshall Furnace Co., Marshall, Mich.; one barrel to the Auto Specialties Mfg. Co., St. Joseph, Mich.; a 3000-pound elevator to the Bostwick Stove Co., Lapeer, Mich.; four brass furnaces to Kohler & Lattimer, Philadelphia; and a cupola to the Insulating Products Co., Chicago. Sales of the National Engineering Co. include a 6-foot sand mixer to the American Nickel Co., Clearfield, Pa. Frank D. Chase, Inc., has been retained as engineer for the design of the brass foundry of the Prime Mfg. Co., Milwaukee, to be one and two stories, 60 x 120 feet. The Rundle Mfg. Co., Milwaukee, and the Commonwealth Steel Co., St. Louis, will install sand blast and dust arrester equipment, made by the Pangborn Corp., Hagerstown, Md. Recent purchasers of sand blast and dust arrester equipment in the Chicago territory include Belle City Malleable Iron Co., Racine, Wis., Chicago Bearing Metal Co., Chicago, Ford Motor Co., Detroit.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Martin Metals Foundries, Inc., Jersey City, N. J., has been incorporated for $100,000.

Berkeely Brass Foundry Co., Berkeley, Cal., has been incorporated for $15,000 by Gust Engelbrekt.

The foundry of Walker & Stuart, Plainville, Conn., was damaged on Nov. 12 with loss of about $1000.

The Amesbury Brass & Foundry Co., Amesbury, Mass., has been incorporated for $150,000 to manufacture brass castings.

Franklin Foundry Co., Cleveland, has been incorporated for $10,000 by J. E. Hurdie and M. E. Birch.

The Saco-Lowell Shops foundry at East Deering, Me., has been closed and operations transferred to Biddeford, Me.

Norton Co., Worcester, Mass., manufacturer of abrasives and grinding machinery, plans constructing 47 x 95-foot, 1-story building on D street.

Pacific Coast Iron Pipe & Foundry Co., Los Angeles, has been incorporated for $500,000. R. P. Drummon is chairman of the board of directors.

The foundry of the Victor Heater Co., 208 South Eighth avenue, Marshalltown, Iowa, was damaged by fire recently with loss of about $15,000.

Consumers' Foundry Co., Inc., New York, has had petition of bankruptcy filed against it, with liabilities reported at $10,000 and assets about $3000.

North Buffalo Hardware Foundry, Buffalo N. Y., has been incorporated with $150,000 capital stock and 3000 shares no par value stock by C. D. Matthews of Detroit.

The American La-France Fire Engine Co., Elmira, N. Y., operator of a brass and aluminum foundry, will apply part of $2,000,000 just received from sale of three-year 6 per cent debenture notes to the extension of its production.

Nugent Steel Casting Co., 3100 South Wood street, Chicago, has retained Frank C. Chase, Inc., as engineer for 2-story, reinforced concrete pattern storage building.

New Bern Machine Shops & Foundry Co., New Bern, N. C., has been incorporated by W. H. Henderson, O. W. Lane, and others of that city.

Fire damaged the plants of the Gluntz Brass Foundry Co., and the Ohio Pipe Bending & Machine Co., Cleveland, on Nov. 10, with loss of about $75,000.

Steffens-Amberg Co., Newark, N. J., operator of a brass aluminum foundry, is revising plans on a 4-story, 75 x 100-foot forge shop. A. T. Steffens, 262 Morris avenue, is in charge.

Landers, Frary & Clark, New Britain, Conn., operator of a brass foundry, has let contract for constructing 6-story, 68 x 161-foot factory addition.

Manville Jenckes Co., Pawtucket, R. I., formerly operator of a gray iron foundry under the name of the West Bridgewater Foundry Co., West Bridgewater, Mass., has discontinued the business and is offering the plant for sale.

The Maytag Co., Newton, Iowa, operator of a gray iron, brass and aluminum foundry, contemplates constructing additional aluminum foundry costing from $200,000 to $300,000. L. B. Maytag is president.

The Arcade Malleable Iron Co., Worcester, Mass., has been incorporated for $500,000 by Edward C. Mason, Winchester, Mass.; Harold G. Storke, Arlington, Mass., and Clarence J. Lamb, Providence, R. I.

Crouse & Pope Foundry Corp., Auburn, N. Y., has been incorporated for $100,000 by E. D Clapp, W. Crouse and W. J. Henry J. Taber, Auburn, N. Y., is attorney.

The plant of the Union Stove Works, Peekskill, N. Y., operator of a gray iron foundry, was damaged by fire with a loss of about $400,000. The burned area covered about 50,000 square feet.

Hood Furnace & Supply Co., Front street, Corning, N. Y., operator of a gray iron foundry, was damaged by fire recently when the machine and carpenter shops in the south wing of the foundry building were burned.

J. B. Foote Foundry Co., Frederickstown, O., operator of a gray iron and aluminum foundry, will erect a 30 x 100-foot addition to its plant here for rattling and grinding departments. It will transfer molding operations to the room now used for grinding, and will take on about 10 more molders.

Mid-West Engine Corp., Nineteenth street and Martindale avenue, Indianapolis, operator of a gray iron, brass and aluminum foundry, has had suit filed against it asking for appointment of a receiver. The Mid-West corporation is successor to the Mid-West Engine Co., the assets of which were sold to the former about six months ago by Frederick Van Nuys, receiver.

The Hull Iron & Steel Foundries, Ltd., Hull, Que., operator of a gray iron and steel foundry, and manufacturer of railroad equipment, is preparing plans for a 100 x 600-foot building at Ogdensburg, N. Y., to contain pattern department, machine shops, etc., the total to cost about $1,000,000. A. H. Coplan is president.

Stoves, ranges and some machine castings will be manufactured by the recently incorporated Leonard & Hamilton Foundry Co., Taun-

ton, Mass. Mr. Leonard, one of the organizers of the new company, was formerly with the Leonard & Baker Stove Co. and Mr. Hamilton was connected with another foundry in practical work.

Tentative plans are being drawn for the Maryland State penitentiary at Baltimore, to provide it with a 1-story, 100 x 233-foot foundry, of concrete, brick and steel, with monorail system of conveying, 1 cupola, etc. Construction is contingent upon the appropriation of necessary funds by the legislature.

Victory Mfg. Co., Box V, Rockingham, N. C., was organized recently to manufacture a patented cotton stalk cutter. It will construct a plant and install general machine shop and foundry equipment. F. I. Mason is president and general manager, and W. A. Williams, secretary and treasurer.

Ferro Machine & Foundry Co., East Sixty-sixth street and Hubbard avenue, Cleveland, operator of a gray iron foundry, plans 100 x 200-foot steel addition to its plant to be used for production of automobile castings. The additions will cost about $75,000. H. K. Ferguson Co., is general contractor.

New Trade Publications

CASTINGS—Malleable castings are discussed in a bulletin recently published by the American Malleable Castings association, 1900 Euclid building, Cleveland. Physical properties, service and uses are pointed out.

LIFT TRUCK PLATFORMS—An illustrated folder describing steel and hardwood construction of truck platforms and emphasizing the necessity of centering loads, has been published by the Lewis Shepard Platform Corp., of Boston.

AIR COMPRESSORS—The various parts of a straight line air compressor are illustrated and described in a bulletin published by the Sullivan Machinery Co., Chicago. Lubrication and construction details and a table of dimensions, indicated horsepower, etc., are included.

SANDBLAST EQUIPMENT—The Pangborn Corp., Hagerstown, Md., has issued an illustrated folder showing several types and sizes of hose machines and sand-blast cars. Each machine is illustrated and described briefly.

GASOLINE STORAGE—S. F. Bowser & Co., Inc., Fort Wayne, Ind., recently has issued a pamphlet in which various types of gasoline and oil storage and distributing equipment is described. Agitators, pumps, indicators, meters, and other accessories also are illustrated and described.

AIR HOISTS—Hoists of the vertical, horizontal, balanced and compound types are described and their application to various industries shown by illustrations, in a 25-page catalog recently published by the Whiting Corp., Harvey, Ill. Valves, valve parts, trolleys, and compressed air elevators also are illustrated.

WELDING EQUIPMENT—The Torchweld Equipment Co., Chicago, recently has published a 40-page catalog which contains descriptions and illustrations of oxyacetlene cutting and welding apparatus including both parts and assembled units. Details of construction are shown by means of diagrams.

FLEXIBLE COUPLINGS—Couplings which compensate for parallel misalignment are described in a pamphlet recently issued by the Thomas Flexible Coupling Co., Warren, Pa. Several reproductions of blue prints with diagrams of couplings and tabulated data are included.

CORE OVEN EQUIPMENT—The Whiting Corp., Harvey, Ill., has issued a catalog in which illustrations and descriptions of core ovens, cars, benches, trucks, racks, etc., are given. Both car type and drawer type ovens are illustrated and some construction details are shown in diagrams.

TOOL CHART—The Independent Pneumatic Tool Co., 600 West Jackson boulevard, Chicago, is distributing a wall chart which contains a complete list of parts for an electric drill. The purpose of the chart is to obviate duplication in the ordering of replacement parts and to avoid unnecessary letter writing.

DRILLING MACHINERY—The Sullivan Machinery Co., Chicago, has issued two catalogs which pertain to air and steam drills and drill sharpeners. Rotator and auger drills and shanking tools are illustrated and described. Considerable attention also is given to sharpeners for hammer forging drill bits and shanks.

DIESEL ENGINES—A catalog recently issued by the Fulton Iron Works Co., St. Louis, contains an account of the manufacture and operation of diesel engines. A number of plant installations, parts, accessories, etc., are illustrated and fuel and heat consumption and amount of cooling water required are represented by means of diagrams.

METAL LATH—The Truscon Steel Co., Youngstown, Ohio, recently published a data book containing specifications, details, tables and practical information concerning metal lath. Numerous applications of the lath are illustrated, in some cases only the lath base being shown and in others the completed rooms being represented.

RIVETERS—Pneumatic and hydraulic riveters, parts and accessories are described completely with the aid of diagrams and photographs in Catalog No. 5, published by the Hanna Engineering Works, Chicago. Operation of a riveter is pointed out by means of a diagram and photographs show the machine in actual use.

AIR VALVES—A folder issued by Tate-Jones & Co., Inc., Pittsburgh, shows illustrations of air gate valves, and an oil strainer for use in a fuel oil feed line. The air valves described are for use in lines where the pressure ranges up to 5 pounds. Loss of power and fuel due to leaks in the air lines and shut-offs is pointed out.

ALTERNATING CURRENT MOTORS—A small booklet in which polyphase squirrel cage induction motors are illustrated and discussed has been published by the Century Electric Co., St. Louis. The adaptation of the motor to uses such as the driving of printing presses, kneading machines, blowers, pumps, lathes, etc., is shown in the leaflet.

VERTICAL WATER TUBE BOILER—The Wickes Boiler Co., Saginaw, Mich., has issued a 16-page bulletin in which the utilization of waste heat for steam generation is outlined. Points of excellence in the company's line of vertical water tube boilers for waste heat service are pointed out on one page of the bulletin and these include the following: Tubes are straight and vertical in position; mud drum is located below the tubes so impurities will be deposited into it; the arrangement of the tubes provides for a smooth uniform, high velocity circulation of the water and steam as well as a large liberating surface for the separation of the steam; the area of gas passage is small; the boiler is so proportioned that the gases move with moderate velocity parallel to the heating surface and in a great variety of waste heat installations the boiler may be operated with natural draft.

OXYGEN—M. Keith Dunham, 110 South Dearborn street, Chicago, has issued a booklet describing the plant and process employed by him in producing oxygen from the air by the liquefaction method. A drawing illustrates the equipment used and the courses of the air and separated oxygen and nitrogen are indicated by lines of different colors. Typical installations are shown together with a log sheet from one of the plants.

SWITCHBOARD INSTRUMENTS—A circuit breaker which cannot be closed when an overload exists is described and illustrated in a bulletin which has been issued by the Roller-Smith Co., 233 Broadway, New York. Another bulletin published by the same company contains illustrations of different meters for switchboard use, and descriptions of other recording instruments such as synchroscopes, electrostatic ground detectors, etc.

STEEL FORGING INSTRUCTIONS—The Vanadium Corporation of America, New York, has issued a sheet of instructions concerning the forging of carbon vanadium steel. The effect of vanadium, the elastic limit of steel and its ability to decrease the danger of injury from overheating are pointed out. The necessity of obtaining proper forging temperature, and normalizing of forgings is emphasized. The instructions also have been put out on heavy waterproofed cardboard for posting in shops.

MOTOR-DRIVEN CHAIN HOIST—A 4-page illustrated bulletin is being circulated by the Motorbloc Corp., Philadelphia. It describes the operation of a portable electric hoist consisting of a standard chain hoist and electric motor and which is intended to be used where load lifting operations occur too frequently for the practical use of chain blocks, but not often enough to justify elaborate hoisting machinery. The hoists are manufactured for capacities ranging from ¼ to 10 tons. The features emphasized by the manufacturers are the bath-oiled gear reduction, the multiple steel disk clutch and the controller. The motors and controllers are constructed for standard alternating and direct current circuits.

PORTABLE ELECTRIC TOOLS—The Hisey-Wolf Machine Co., Cincinnati, has issued a 32-page catalog of the portable tools which it manufactures. The equipment includes alternating and direct-current hand drills and reamers of various designs and capacities, bench drilling stands, tool post grinders, bench and floor buffing lathes, angle plate grinders, internal and external grinders, bench and floor grinding machines, and heavy duty floor grinders, together with portable grinders and buffers with extensions. Equipment listed in the bulletin is made for 80 to 550 volts and special voltages are made to order. The catalog describes the machines as being adapted to the heavy duty service of foundries, railroad shops, and similar industries. The feature of the equipment illustrated is the construction of the electric drills, shown by a diagram.

GRAB BUCKETS—An illustrated 35-page pamphlet has been issued by the Blaw-Knox Co., Pittsburgh, and contains detailed descriptions of single line grab buckets for foundry, railroad and dredging use. Single rope cableways are treated in similar fashion and several other items such as standard buildings, concrete forms and water-cooled furnace appliances are taken up briefly and illustrated.